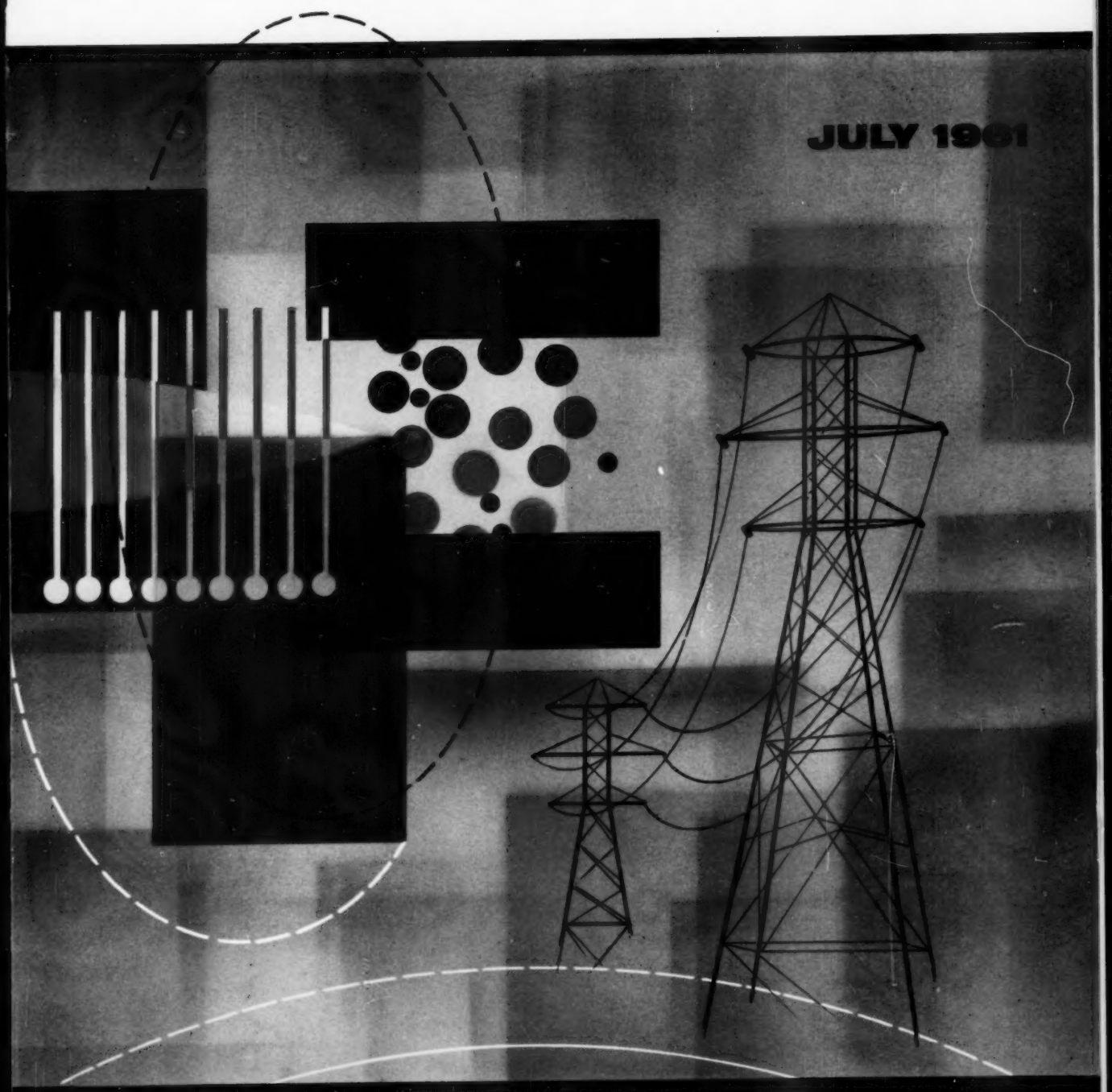
Power Engineering



JULY 1961

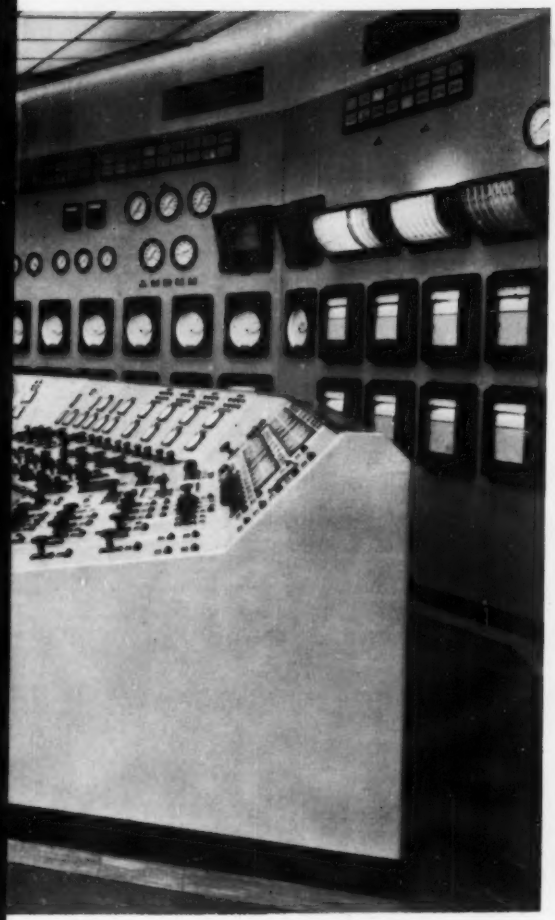
NEW HORIZONS FOR EXOTIC MHD POWER

IT'S BAILEY FOR AMERICA'S

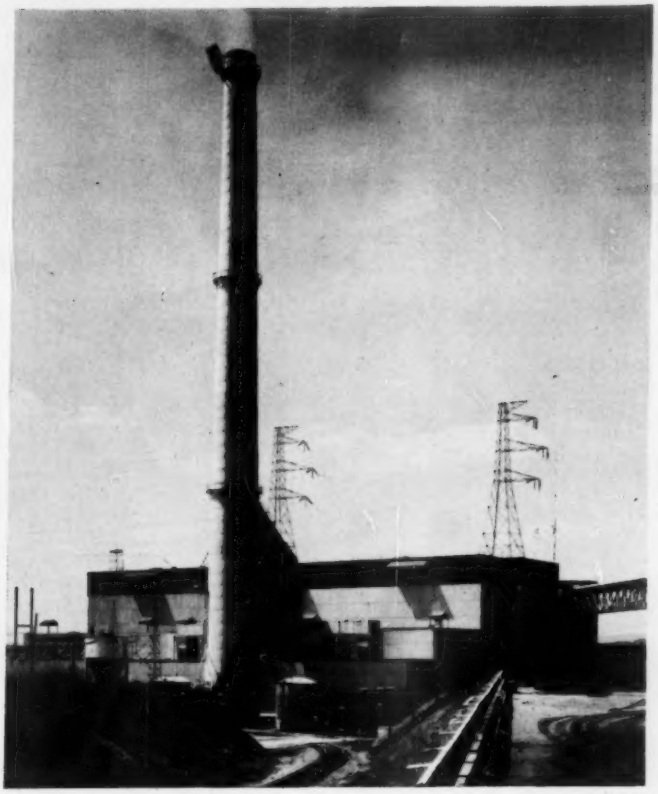
1959 STEAM-ELECTRIC PLANT HEAT RATES FROM FEDERAL POWER COMMISSION REPORT S-143

	Btu/kw-hr	Meters	Combustion Control	Feed Water Control	Superheat Control
1. Dickerson (Potomac Electric Power Co.)	9,007	B	B	B	B
2. Clinch River (Appalachian Power Co.)	9,011	B	—	B	B
3. Kanawha River (Appalachian Power Co.)	9,098	B	B	B	B
4. Silas McMeekin (South Carolina Electric & Gas)	9,130	—	—	—	—
5. Muskingum River (Ohio Power Co.)	9,170	B	B	B	B
6. River Rouge (The Detroit Edison Co.)	9,170	—	—	—	—
7. Clifty Creek (Indiana-Kentucky Electric Corp.)	9,173	B	B	B	B
8. G. G. Allen (Duke Power Co.)	9,174	B	B	B	B
9. Tanners Creek (Indiana & Michigan Electric Co.)	9,176	B	B	B	B
10. Shawville (Pennsylvania Electric Co.)	9,179	B	—	—	B
11. Kammer (Ohio Power Co.)	9,203	B	B	B	B
12. St. Clair (The Detroit Edison Co.)	9,250	B	B	B	B
13. Kyger Creek (Ohio Valley Electric Corp.)	9,284	B	—	B	B
14. Portland (Metropolitan Edison Co.)	9,322	—	—	—	—
15. Oak Creek (Wisconsin Electric Power Co.)	9,336	B	B	B	B
16. Bayshore (Toledo Edison Co.)	9,365	B	B	B	B
17. Milliken (N. Y. State Electric & Gas Corp.)	9,374	B	—	B	—
18. Philip Sporn (Appalachian Power Co.)	9,381	B	B	B	B
19. John Sevier (Tennessee Valley Authority)	9,390	—	—	—	—
20. Mandalay Beach (Southern California Edison Co.)	9,397	B	B	B	B
21. Gallatin (Tennessee Valley Authority)	9,420	—	—	—	—
22. Huntington (Southern California Edison Co.)	9,436	B	B	B	B
23. Colbert (Tennessee Valley Authority)	9,460	B	B	B	B
24. Will County (Commonwealth Edison Co.)	9,460	B	—	B	B
25. Agua Fria (Salt River Project A.I.F. Dist.)	9,473	B	B	B	B
26. Salem Harbor (New England Power Co.)	9,485	B	B	B	B

***per 1959 Heat Rates reported by FPC**



Bailey Controls for combustion, feed water and steam temperatures at the Dickerson Generating Station of Potomac Electric Power Co. The Federal Power Commission reported a 1959 heat rate of 9007 Btu per kw-hr, ranking it as No. 1 plant in efficiency in the United States.



NO. 1* STEAM PLANT

and for 20 out of the next 25 "most efficient" plants, too

Most efficient power plant in 1959, as rated by the Federal Power Commission, was Dickerson Station of Potomac Electric Power Co. And for measuring and controlling functions that helped attain this record, Dickerson relies on Bailey Meters and Controls.

Moreover, *in 21 out of all 26* "most efficient" plants, with heat rates under 9500 Btu per kw-hr, Bailey Meters and Controls are used for some or all functions.

Why? The reasons aren't hard to find. Bailey engineers have worked hand-in-hand with leading power engineers for more than 45 years to advance steam-plant efficiency rates . . . have pioneered the research and development of improved measurement and control techniques that have produced much of today's high reliability of steam-plant operation . . . have simplified and verified instrumentation and control systems to the point where automation can be approached confidently.

And now, working to extend the benefits of automation over the full range of plant operations, Bailey offers systems incorporating advanced techniques for scanning, alarming, logging, computing, digital logic and sequencing . . . all co-ordinated with established analog equipment to provide maximum safety, economy and reliability . . . all compatible with the needs of power management, technical and nontechnical.

Ask your nearby Bailey District Office or Resident Engineer how new Bailey concepts and advanced systems techniques may be applied to your operations.

A-164-2

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Only material proved effective against acids formed by Sulfur Dioxide and Sulfur Trioxide.

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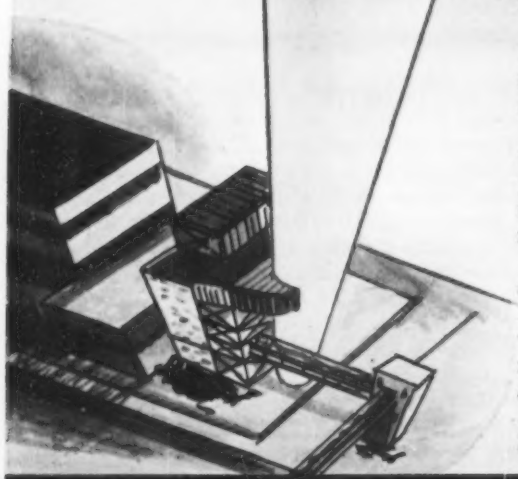
In recent years the cost of new chimney construction and maintenance has skyrocketed due to greater use of more economical low cost coal, heavy fuel oil, refinery sludge and sour gases which form stronger acids resulting from the use of these high sulfur fuels. The lowering of the gas temperatures through the use of economizers has increased the problem. Heretofore no coating has succeeded in resisting these highly corrosive acid gases.

Now, after two years of intensive research and testing, Benjamin Foster Company releases STACKFAS—the world's first exclusive corrosion resistant material proved effective against high sulfur chimney gases.

Foster STACKFAS has been field tested and proved by twenty-four major public utilities, chemical and industrial plants. Its development program had the cooperation of the nation's most renowned consulting engineers, insulation manufacturers and chimney constructors.

Rarely has a product been subjected to such wide study and testing. This cooperation was made possible because it was apparent from the outset that Foster STACKFAS would make obsolete all previous specifications and recommendations for the protection of chimneys and stacks against corrosive flue gases.

For complete details, specifications and applications of Foster STACKFAS, write for Bulletin No. SF-61.



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Comment

Seventy-five years ago George Westinghouse started building electrical equipment in Pittsburgh. A newly invented device, known as a transformer, gave George's young company a fine start in the world.

In rapid succession, many other electrical products started coming from Westinghouse. First of these related to generation and transmission.

Over the years, this famous company has progressed into almost every electrical device known — and some unknown. In this issue we salute George Westinghouse's grown-up company, and its part in our national economy.

Bob McCaw

EDITOR

Power Engineering

Our Electric Power Apparatus . . . And How It Grew 41
Water Analysis Is Big Business in New Laboratory 44
Will Nuclear Power Replace Coal, Oil, and Gas? 46
Southwest Grid to Provide for 500-kv Transmission 49
Design Criteria of EHV Transmission Systems 50
So You're Buying a Water-Tube Package Boiler! 56
Generating Electric Power From Gas Jets 59
Portable Coal Crusher Permits On-the-Spot Sampling 62
Radar-Relay-Camera Team Pinpoints HV Line Faults 64
The Story of Coal From Mine to Boiler — Part Five 66
Power for a Giant 70
Now . . . A Mobile Nuclear Power Plant 72
Transmission and Distribution Committee Meets 74

Around the Power Circuit . . 4
Who, What, When 8
Current Catalogs 31
News Reel 54
New Engineering Books . . . 79
New Power Construction . . . 80
Reader Service Post Cards . . 85
Equipment News 88
Advertisers' Index 100
Circulation This Issue 43,465

Complete editorial index

ON THE COVER

MHD has come into the spotlight as one of our most interesting new power sources. Cover drawing symbolizes high-temperature flame, passing through a magnetic field, to produce power.

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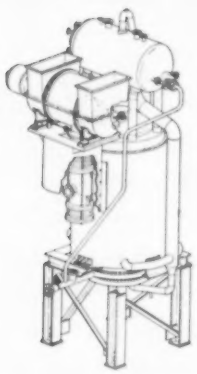
around the power circuit



Combustion air at a pressure of 60 pounds per square inch gage is supplied to supercharged boiler from a gas-turbine-driven air compressor

NATION'S FIRST gas turbine package power plant is a unit developed by GE. It will be shipped to the South Carolina Electric & Gas Co., which has purchased four of the 11,250-kw units. South Carolina Electric & Gas has recently installed more than 200 miles of natural gas transmission lines in its 23-county service area, enabling it to capitalize on the versatility of the gas turbine to help assure a continuing supply of low-cost electric power.

The new package power plant is rated 11,250 kw for peak service at NEMA conditions—80 F and 1000-ft altitude. Over-all dimensions of the package power plant are approximately 80 ft long, 22 ft wide, and 16 ft high. The design is suitable for operation at ambient temperatures from a minimum 40 F to 120 F.

FIVE NEWLY-DEVELOPED supercharged boilers, each weighing only half that of a conventional boiler of the same capacity, have been ordered by the U.S. Navy under a $2.5 million contract with Foster Wheeler Corp. The company believes that this development will lead to significant improvements in cycle efficiency, particularly in the case of electric utility generating plants firing natural gas and, ultimately, oil and pulverized coal.

Believed to be the first practical supercharged boilers ever produced in this country, the units will be used by the Navy to power a new class of destroyer escorts.

FPC has authorized Iowa Power and Light Co. of Des Moines, and Iowa Southern Utilities Co. of Centerville, Iowa, to buy and sell electric facilities.

Iowa Power will sell and Iowa Southern will buy about 13 miles of 115-kv transmission line from Newton, Iowa, to a point near Laurel, Iowa; about 4.3 miles of 46-kv transmission line from Newton to the Metz tapline; and certain metering and related facilities. The purchase price is $195,930.

Iowa Southern will sell and Iowa Power will buy the Prairie City-Skunk River portion (about 7.7 miles) of the Prairie City-Newton 69-kv transmission line and certain facilities in the Prairie City switching station. Purchase price is $96,441.

FPC also announces that it is proposing major revisions in the forms used by the larger electrical utilities and natural gas companies in filing annual reports with the Commission. Proposed new forms would be used for the first time in the annual reports filed for the year 1961, due next spring.

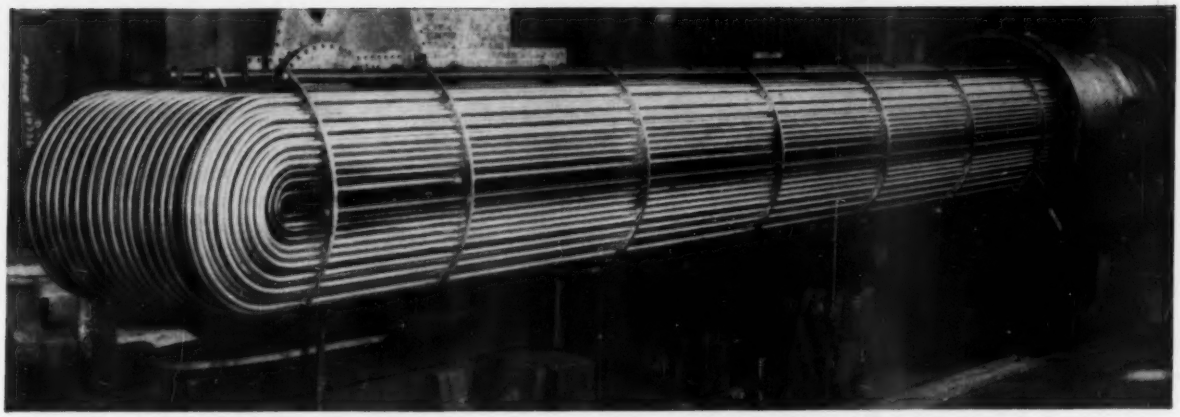
MARKET FIGHT LOOMS and investor-owned electric utility companies must arm for a future of intense competition with other energy sources and government power projects, Sherman R. Knapp, president, EEI, and president, the Connecticut Light & Power Co., asserted at the 29th annual convention of Edison Electric Institute in New York, June 5-7. He said there are no signs of any letup in "the cold war on the government power front," and charged that plans of the Interior Dept., if carried out, would constitute "the highway to complete nationalization of our industry."

By 1970, governments will absorb more than 40 per cent of the people's income "unless we develop a firm concept of limited government and evolve articulate support for this view," predicted Emerson P. Schmidt, director of the economic research dept. of the Chamber of Commerce of the United States.

Arguments against government power are weakest when they are confined to the areas where power consumers benefit the most, said Andrew Heiskell, board chairman of Time, Inc. As an example, he cited the concentration of the campaign against the Colorado River storage project in Denver alone. He said it would be "far more effective" to tell the Pennsylvania taxpayer that he is being hurt by the project than the Colorado taxpayer, for whom the benefits may be greater than the cost.

AIR-CONDITIONED display-on-wheels, featuring operational power circuit breakers and associated equipment, has begun a one-year, cross-country tour for I-T-E Power Circuit Breaker Div., visiting utilities and industrial users of this equipment.

The mobile showroom is divided into three areas. In one area, a single tank 34.5-kv breaker operates in slow-motion with all internal parts exposed. In another section, a 14.4-kv breaker operates at full speed,



This typical bundle of long-length Anaconda U-Bend tube is the heart of the modern feedwater heater. To get optimum capacity and efficiency—and a more economical and compact unit—designers have lengthened heaters instead of increasing shell diameter.

IN POWER PLANT FEEDWATER HEATERS

Anaconda long-length U-bend tubes offer higher efficiency and greater economy

Feedwater heaters play an important role in the efficient operation of a steam power station—and with today's more demanding conditions, the trend is to the use of long-length U-bend tube bundles in these higher pressure, higher temperature heat exchangers.

U-bend tube design reduces the number of tube joints to one-half. Each U-bend tube takes care of its own expansion stresses. There's no floating head—one less gasketed joint—all resulting in a more economical, more compact heater.

Now Anaconda makes heat exchanger tubes to 100 feet. This means U-bend tubes with legs approaching 50 feet are available. And the radius of the bend can be as small as 1½ times the diameter of the tube—or as great as 30 inches. Dual-gage tubes are made with extra wall thickness in the area of the bends, to cut cost and weight.

With a large family of alloys available for heat exchanger tubes, Anaconda can meet almost every requirement. From Arsenical Admiralty-439 to the cupro nickel group, long-length U-bend tubes can be made to handle a wide range of temperatures and pressures.

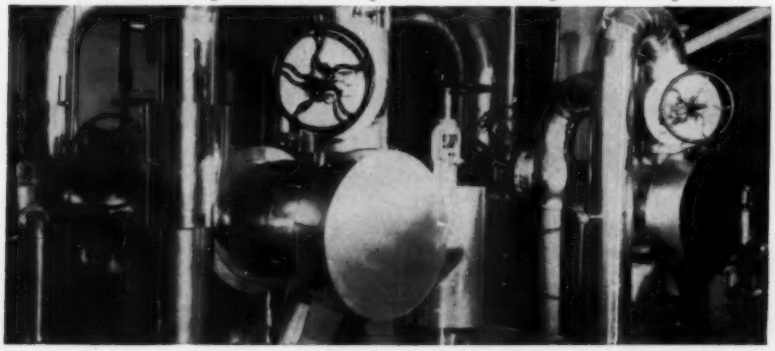
Specialists at Anaconda are constantly working with users and manufacturers of heat exchange equipment, helping to solve individual problems. This experience is available to you. For more detailed information on duplex tubes, dual-gage as well as U-bend tubes, see your Anaconda representative. Or write to: Anaconda American Brass Company, Buffalo Division, Buffalo 5, New York. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. 6061

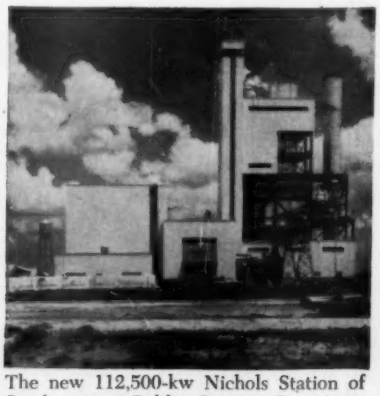
ANACONDA®

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

Anaconda American Brass Company

Two of the three feedwater heaters at Nichols Station, using a total of 1692 Anaconda U-bend tubes of Arsenical Admiralty-439. Griscom-Russell Co., Massilon, Ohio, designed and built the heaters. U-bend bundles of longer, smaller diameter tubes provide a more effective surface, make possible more compact units. Heaters operate at 200 psi, 450°F.





The new 112,500-kw Nichols Station of Southwestern Public Service Co., Amarillo, Texas.

For more data circle 503 on Post Card

also with all internal parts exposed for easy viewing. Third area displays the I-T-E arc interrupter and other component parts.

around the power circuit

MIDWEST PIPING CO. has been acquired by Crane Co., and will be operated as a division of Crane, under the supervision of Norman B. Champ, Jr. Formerly a vice-president and director of Midwest, Champ has been elected a vice-president of Crane.

ROOF-TOP ALL-ALUMINUM 138-kv substation is expected to be on the line for Consolidated Edison's East River switching station in February of next year.

Equipment for the 39-ton station is being shipped from designer General Electric's high-voltage switchgear dept. in Philadelphia. Because of low station profile requirements, horizontal-break Type RC double-break air switches are being used. Con Ed ordered eight 161-kv, 1200-amp switches and fourteen 161-kv, 2000-amp group-operated disconnecting switches.

Thirty-four outdoor, group-operated Type FB-4 grounding switches, 161-kv, 1200-amp, mounted as an integral part of the double-break main switches complete the order.

MOLECULARIZED COMPUTER, one-tenth the size and weight of a transistorized computer and with the same capabilities, is now under development at Westinghouse. The new device will reportedly have greater payload capabilities for American rockets through the use of this new approach.

Molecular electronic circuitry makes unnecessary the familiar tubes, transistors, and resistors of the type found in a television set. In place of these components, a solid semiconductor crystal performs the same functions through the rearrangement of its internal structure to form a functional electronic block.

Mol-E-Com is designed to weigh less than 15 lb and occupy less than one-third of a cubic foot instead of the 175 lb and three cubic feet required by a similar conventional transistorized computer.

BARK-BURNING BOILER has been installed at the West Monroe, La., pulp and paper mill of Olin Mathieson Chemical Corp. The $1.5-million boiler is part of a $12-million program of plant modernization. It permits the conversion of waste bark into electric energy, increasing the plant's electric generating capacity by approximately 10 per cent. In the past, the bark was burned with no heat recovery.

Boiler was supplied by Riley Stoker Corp. Ford, Bacon & Davis Construction Corp. handled the engineering and installation. Ebasco Services, Inc., was engineering consultant on the job.

ASTM has available a 62-page list of publications describing the symposiums, manuals, special publications, indexes, compilation of standards, charts, reference photographs and reports published by the Society through the years. More than 300 items are fully described, 40 of which are new and not previously listed. List may be obtained free from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Penna.

ALLIS-CHALMERS has been awarded the contract for the final two generators for Units Nos. 7 and 8 at the U.S. Army Corps of Engineers' Bull Shoals powerhouse on the White River in central northern Arkansas.

The 47,368-kva, 0.95-P.F., 13,800-volt, 128.6-rpm generators are similar to those for Units Nos. 5 and 6 supplied earlier by Allis-Chalmers and now being installed at the powerhouse.

CONTRACT to construct the $2,664,000 first stage of Lower Monumental Lock and Dam on the Snake River in eastern Washington has been awarded to Henry J. Kaiser Co., as the sponsor, and Puget Sound Bridge & Dry Dock Co. as participant. Contracting agency is the Corps of Engineers, U.S. Army Engineer District, Walla Walla.

The finished dam will consist of a concrete spillway dam across the Snake River with a lock on the south shore and a powerhouse with an initial power capacity of 363,000 kw on the north shore. The dam will be tied into each bank with earth embankments.

AN INFORMATIVE 32-page brochure titled How To Train Electronics Personnel has just been published. Copies may be obtained by writing to the Cleveland Institute of Electronics, 1776 East 17th Street, Cleveland 14, Ohio.

SECOND of two 320,000-kw generating units at the new Mercer Generating Station has been placed in commercial operation by Public Service Electric and Gas Co. This unit and the first unit, placed in operation in December 1960, are the largest in operation in New Jersey.

During April of this year Mercer Generating Station No. 1 produced 17 per cent of the electric system output at a heat rate of 8720 Btu per net kilowatt-hour. The two units at Bergen Generating Station, completed last year, with Mercer No. 1, accounted for 45 per cent of the system output for April at a combined heat rate of 9009 Btu per net kilowatt-hour.

Historically, the system annual heat rate has improved from 17,000 Btu per net kilowatt-hour 30 years ago to 10,515 Btu per net kilowatt-hour in 1960. This represents an increase of 12 per cent in thermal efficiency.

HIGH TEMPERATURE MATERIALS, Inc., has announced development of a new nuclear fuel called fuel pressure spheres, which will allow generation of uncontaminated 1200 F steam at 5000 psi without auxiliary heating or heat exchangers.

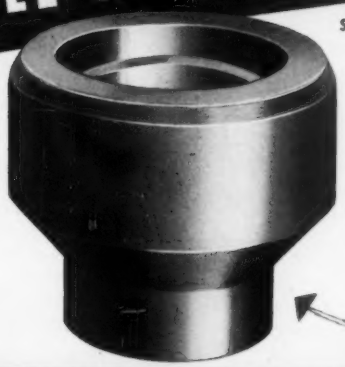
Fuel particles have diameters of 100 to 300 microns. Significant savings in fabrication and handling costs result from the combination of impermeability and strength unique to pyrolytic graphite. Coated sand-size fuel particles are dispersed within 2½-inch graphite balls using low-

Continued on page 76

Another* Exclusive Vogt Product

THREADED TYPE

FORGED STEEL WELD COUPLETS



SOCKET WELD TYPE

The Vogt Weld Couplet is an easy-to-install fitting for branch connections from pipe, vessels or tanks. It replaces more-difficult-to-install welding bosses, couplings and the type of fittings requiring trimming or matching to fit contour of vessel or pipe.

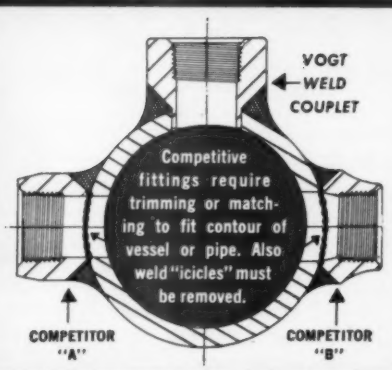
*with Exclusive Vogt "WELD RING"

Here's How the Exclusive VOGT "WELD RING" Saves Time and Money!

Small Diameter Pipe — Large Diameter Vessel

Vogt Weld Couplets adapt to any pipe or vessel curvature by simply adjusting the height position of the couplet when welding. This characteristic means easy installation, positive positioning and alignment, a stronger weld without distortion, and no inside "icicles" of welding material.

Couplets are available in carbon steel, conforming to A.S.T.M. specifications. Other materials can be supplied on special order.


VOGT
WELD
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Competitive fittings require trimming or matching to fit contour of vessel or pipe. Also weld "icicles" must be removed.
COMPETITOR "A"
COMPETITOR "B"

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Vogt VALVES, FITTINGS FLANGES & UNIONS

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who

Dick Morris of POWER ENGINEERING met with power engineers in Prague in May. Reading from top: Dick Morris; Karel Texl, director of engineering of ENERGOVOD and president of the Power Section, Czechoslovak Scientific & Technical Society; Jan Obsolsobe, chairman, Czechoslovak National Committee, World Power Conference; Eva Vergeinerova, international relations officer, Czechoslovak Scientific & Technical Society; Ladislav Nemec, secretary, and Prof. Otakar Mastovsky, secretary and vice-chairman, Czechoslovak National Committee, World Power Conference.

Harold Lee is the new executive director of Mid-West Electric Consumers Association. Headquarters of the regional service organization will be moved to Denver.

Ivan L. Bateman, chief electrical engineer and assistant manager, Dept. of Water and Power, Los Angeles, Calif., was elected president of the American Public Power Association at the annual convention in San Antonio.

William F. Wyman, president of Central Maine Power Co. since 1947, has been re-elected to head the company.

John H. Hemsarth, formerly with United Engineers and Constructors, Inc., has been appointed general manager, Power Division of the Fluor Corp.

Allis-Chalmers has announced the appointment of **James J. Dickson** as assistant manager of the Nuclear Power Dept.-Washington. In other appointments, **Joseph V. Cupo** becomes manager of engineering, and **Joseph H. Blachly** manager of projects of the Nuclear Power Dept.-Washington.

American-Standard has placed **Ben Ragland** in charge of future planning, development and marketing of dust collection and air pollution control equipment.

Dr. Hans A. Bethe, renowned nuclear and theoretical physicist and professor of physics at Cornell University, will receive the U.S. Atomic Energy Commission's Enrico Fermi Award for 1961.

Moloney Electric Company has appointed **Donald E. Spackler** general manager of the new Switchgear Division.

Roy M. Casper is now general manager, Allis-Chalmers Power Equipment Division. He succeeds **J. W. McMullen,** who is retiring after some 45 years of service.

Central Illinois Light Co. has appointed **Oscar L. Sundstrom** as assistant operating vice-president.

Merl C. Kelce of St. Louis, a former coal miner who worked his way up through the ranks to head the nation's second largest coal company, received one of the 1961 Horatio Alger Awards. Mr. Kelce is president of Peabody Coal Co.

John G. Trump, of Massachusetts Institute of Technology, has been awarded AIEE's 1961 Lamme Gold Medal. Dr. Trump is widely known for his design of high voltage X-ray and electron sources used in medical research.

Claude K. Rice, of the Gulf Oil Corp., has received the 8th Max Hecht Award presented by the American Society for Testing Materials' Committee D-19 on Industrial Water.

Samuel G. Lasky of Denver has been appointed assistant director of the Dept. of the Interior's newly organized Office of Coal Research.

what

Brown Boveri Corp., U.S. subsidiary of the organization headquartered in Switzerland, has launched a promotional counterattack on the "Buy American" theme. Pointing to the fact that the U.S. enjoyed a $5-billion favorable balance of trade in 1960, President **Paul R. Sidler** said:

> Too many people are forgetting that trade is a two-way street, and you can't have a high level of exports without accepting some imports. We don't believe in "Buy American" any more than we believe in "Buy Swiss." If the friendly nations of the Free World, led by the United States, can't do business together, we are all going to be in a very bad position when we are forced to meet real trade pressure from Russia and other communist nations.

when

American Management Association has scheduled two workshop seminars at its Management Training Facilities Center on the campus of Colgate University in Hamilton, N.Y. The meetings, to be held July 31-Aug. 4, 1961, are: Organization & Management of the Facilities Engineering Function, and Organization & Management of the Maintenance Function.

AIEE, Pacific General Meeting will be held at Hotel Utah, Salt Lake City, Aug. 23-25.

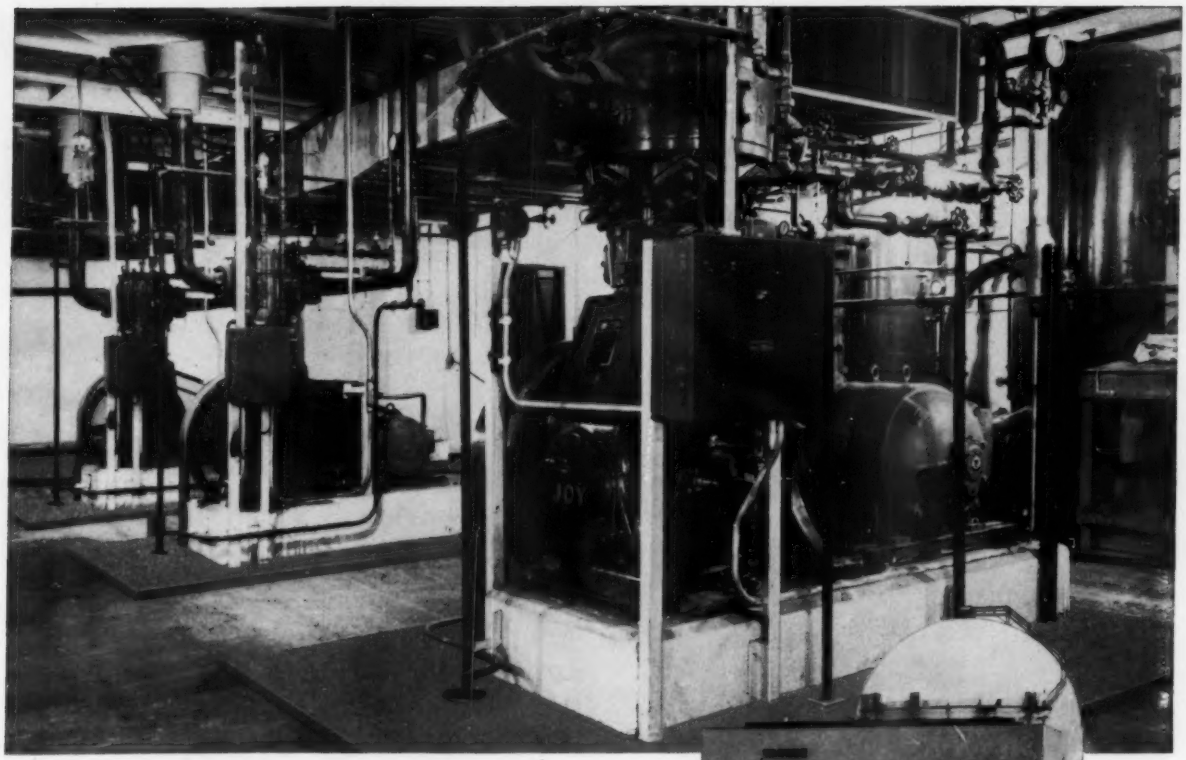
ASME, International Heat Transfer Conference is scheduled for the University of Colorado, Boulder, Aug. 28-Sept. 1.

Latin American Power Seminar, Mexico City, July 31-Aug. 12.

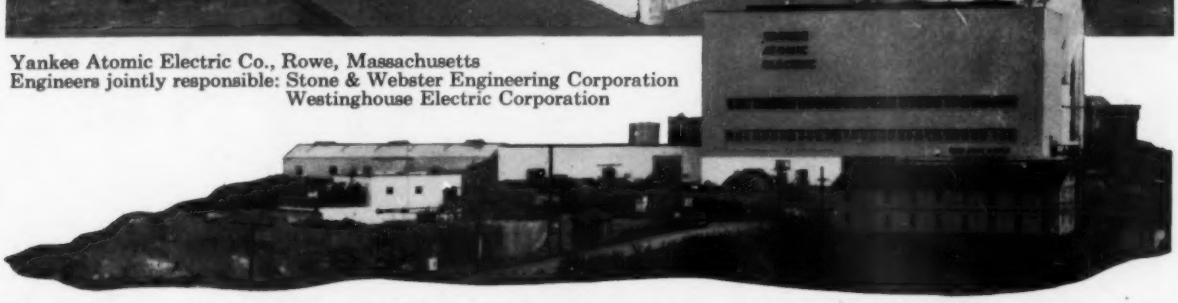
ISA, AIEE, IRE Joint Nuclear Instrumentation Symposium, North Carolina State College, Raleigh, Sept. 6-8.

National Association of Corrosion Engineers, North Central Regional Meeting, Chase Park Plaza Hotel, St. Louis, Mo., Oct. 9-11; South Central Region conference and exhibition, Shamrock Hilton Hotel, Houston, Oct. 23-26.

National Electronics Conference, Inc., 17th annual meeting, International Amphitheatre, Chicago, Oct. 9-11.



Yankee Atomic Electric Co., Rowe, Massachusetts
Engineers jointly responsible: Stone & Webster Engineering Corporation
Westinghouse Electric Corporation



Yankee Atomic Electric chooses JOY Compressors for New England's first Nuclear Power Plant

Compressed air requirements at the Yankee Atomic Electric plant are not large but vitally important. Reliability of all machinery is a must, once the reactor goes critical. Two Joy WGO-9 vertical compressors supply oil-free air for instruments and controls. Each machine produces 172 cfm at 100 psi and is V-belt driven by a 25 horsepower motor. Carbon graphite piston rings completely eliminate lubricating oil in the cylinders. The compact vertical design requires less than seven square feet of floor space for each installation.

General service air is supplied by a 100 hp Joy WG-9H compressor producing 769 cfm at 100 psi. This machine has the same space-saving vertical design in sizes up to 150 hp.

Joy compressors are chosen for many of the country's finest installations . . . there is a size and type for you, reciprocating, centrifugal or axial. For information, write for bulletin 1685-56C.

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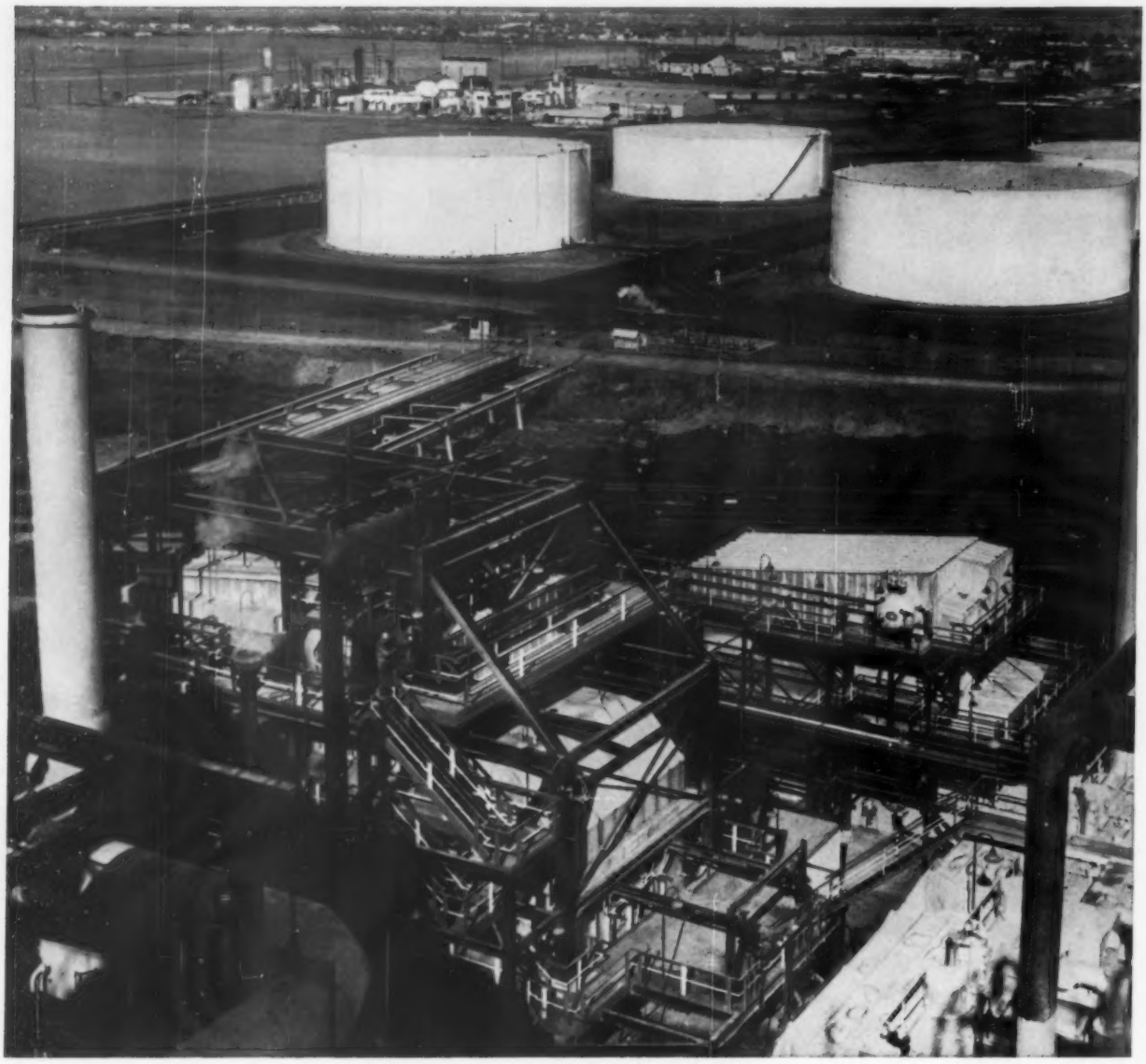


At Richfield Refinery, B&W boiler "team" provides

dependable operation with maximum

Two highly efficient B&W boilers of entirely different designs – system engineered into a money saving "team" – are providing operating flexibility and dependability at Richfield's Wilmington, California refinery.

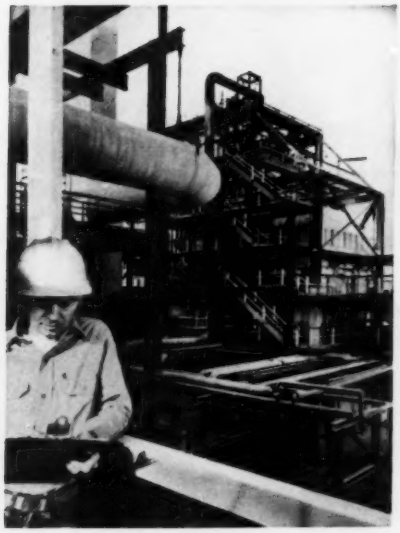
The two boilers are the CO* Boiler, which operates on waste gases from the refinery process, and the PFI, which burns refinery gas, natural gas, or oil with equal ease.

The CO Boiler has been base loaded at 340,000 lbs./hr. full load since its installation in 1954, with an availability exceeding 96%. Developed and pioneered by B&W, the CO Boiler improves refinery economy by burning cat-cracker gas that would otherwise be wasted. The Richfield unit is typical of the many CO Boilers that have solved air pollution problems.

Supplementing the steam produced by the CO Boiler, the PFI boiler is equipped to use the lowest cost auxiliary fuel, whether oil or gas, at all times.

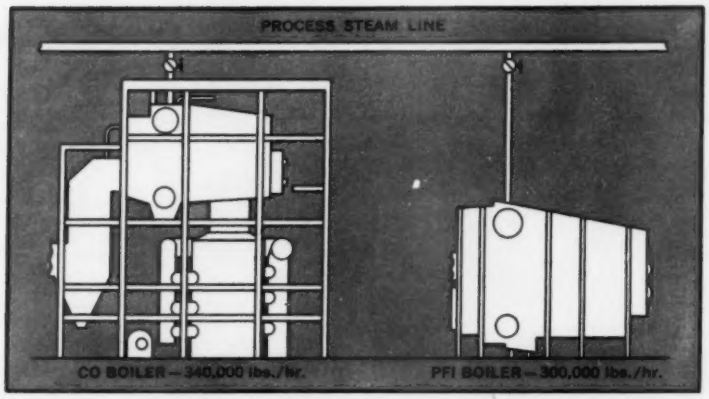
*Reg. U.S. Pat. Off.

MAXIMUM AVAILABILITY — No unscheduled outages have occurred since the CO Boiler (left) and the PFI boiler (right) went on the line. This complete freedom from unscheduled shutdowns plus sustained high efficiency provides Richfield with dependable steam at 640,000 lbs./hr.



PAYS FOR ITSELF—Burning catcracker gas that would otherwise go up the stack and pollute the atmosphere, the B&W CO Boiler cuts operating costs to the extent that it, and others like it, pay for themselves in fuel savings in less than 3 years.

FLEXIBILITY OF OPERATION — The PFI boiler helps keep steam generation costs down by providing immediately all needed steam in excess of that which can be obtained by burning the waste gas.



EASY TO OPERATE, INTEGRATED CONTROL CENTER — Fully automated control center equipped with Bailey meters ties this boiler "team" together as a dependable source of low cost steam to meet refinery requirements.

fuel savings

This compact, versatile boiler, designed for 300,000 lbs./hr. supplies steam required in excess of that produced from the waste gases, and responds immediately to changing conditions.

By continually developing more efficient and economical ways to generate steam, B&W has helped many industries to meet growing steam demands at lowest possible cost. For further details, contact The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

G-990-1B

B&W

THE BABCOCK & WILCOX COMPANY

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WHERE DO YOU STAND ON BOILER

TYPICAL USERS OF YARWAY INDICATORS FROM OVER 15,000 INSTALLATIONS

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WILSON & COMPANY
U. S. STEEL COMPANY
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MOBIL OIL COMPANY

UTILITIES

(Code Case #1155 Installations)

COMMONWEALTH EDISON
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WATER LEVEL INDICATION ?

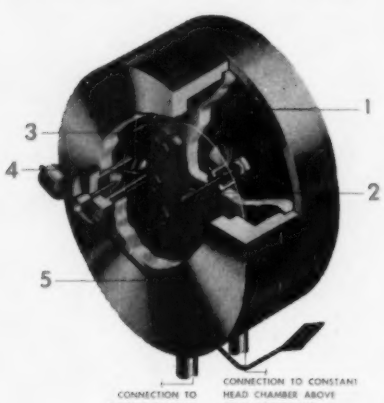
YARWAY REMOTE INDICATORS HAVE BRILLIANT "WIDE ANGLE" VISIBILITY... CAN BE INSTANTLY READ FROM MULTIPLE VANTAGE POINTS

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

GIVE INSTANT, ACCURATE READINGS BECAUSE INDICATOR IS OPERATED BY THE BOILER WATER ITSELF

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.



Constant pressure from a controlled-temperature constant head chamber located above drum level is maintained on one side of diaphragm (1) in indicator. Varying pressure changing with water level is maintained on opposite side of diaphragm. Change in differential between the two pressures moves the diaphragm which in turn regulates, through deflection plate (2), magnet (3), and spiral magnetic armature (4), the position of the counterbalanced pointer (5).

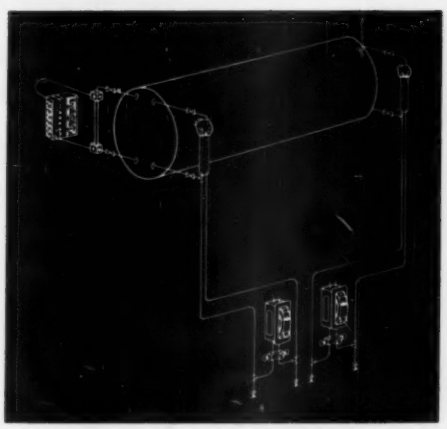
OPERATE ADDITIONAL REMOTE SIGNAL ALARMS, HORNS OR LIGHTS

With the addition of a control unit Yarway Indicators may be equipped to operate auxiliary hi-lo signal alarms, horns or lights located at any place in the plant. Electronic secondary indicators may also be used to duplicate readings at remote points.

FULLY APPROVED AS PRIMARY INDICATING ELEMENTS UNDER BOILER CODE CASE #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used instead of one of two required gage glasses for boiler pressures 900 psi and above. When both indicators are in operation, the gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.



All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin RI-1825.

YARNALL-WARING COMPANY
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BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

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Oval "overcoat" for a problem pipeline

J-M METAL-ON
in "long-legged" form cut insulation costs for Shell Oil

A piggy-back steam tracer line made insulating asphalt pipelines at Shell Oil's Norco, La., plant a problem. Every foot of pipeline—if insulated in standard fashion—would have required insulation a size larger than normal. And there were miles of pipe involved.

Johns-Manville and its contract unit in New Orleans, McCarty-Branton, Inc., studied the problem and made an unusual recommendation. They suggested using elliptically shaped, "long-legged" Metal-On®, the aluminum-jacketed pipe insulation. This oval shaped pipe covering fit right over the asphalt pipes and the troublesome tracer line—and saved substantially in the cost of insulation.

Typically, Johns-Manville had the answer for this insulation problem. *Your* insulation jobs, too, will be solved best by Johns-Manville. For further information, write to J. B. Jobe, Vice-President, Johns-Manville, Box 14, New York 16, N. Y. In Canada, address Port Credit, Ontario. Worldwide, cable Johnmanvil.

JOHNS-MANVILLE

AN INSULATION FOR EVERY COMMERCIAL AND INDUSTRIAL USE

JOHNS-MANVILLE JM PRODUCTS

Close-up of line section showing steam supply line and ½" copper tube tracer atop main line before it is coated with material used to bond it to main pipeline.

SEND FOR FREE SAMPLE

Johns-Manville, Box 14,
22 East 40th Street
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Please send me a sample of Metal-On

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Diamond developed for more economical power...

AIR PUFF BLOWING=CLEANER BOILERS... AN APPRECIATIVE PUBLIC

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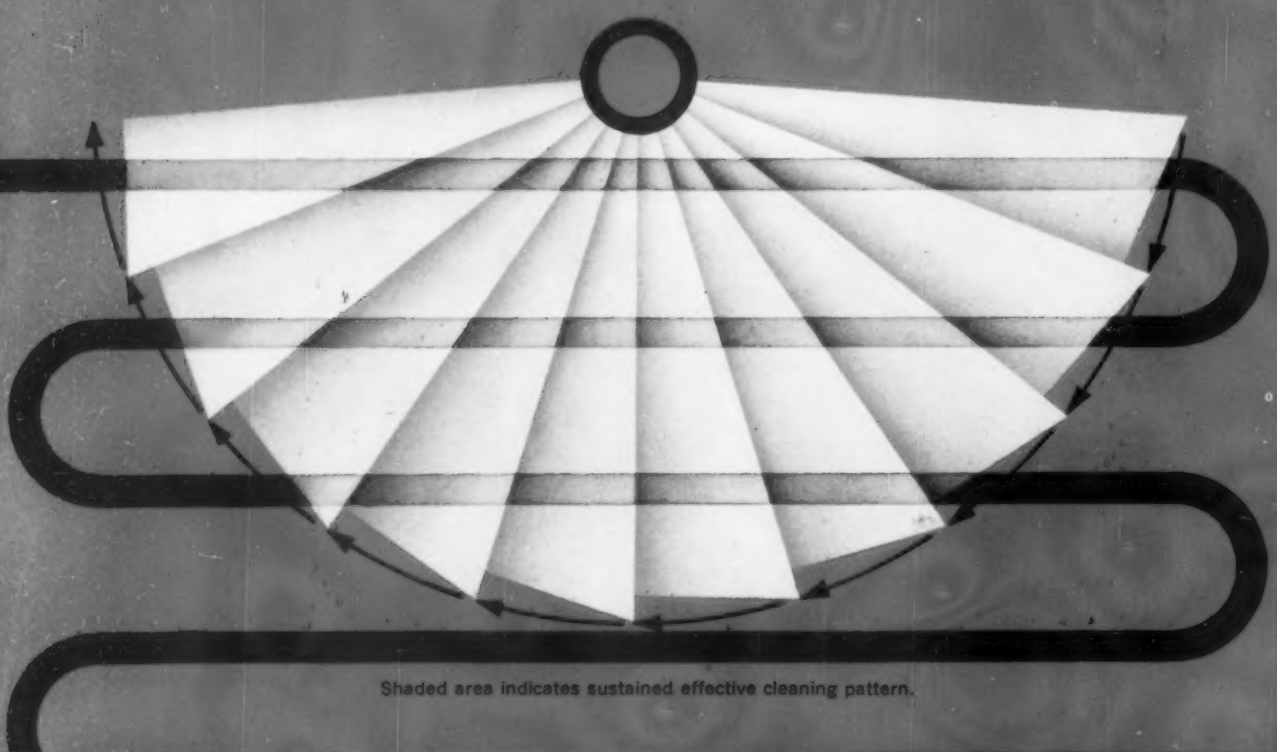

Shaded area indicates sustained effective cleaning pattern.

Two of today's more critical conditions for efficient steam generation . . . clean boilers and acceptable stack emission . . . are assured with Diamond Air-Puff Soot Blowing Systems.

Increased cleaning efficiency is obtained because high density air is used as the cleaning medium and emitted in sustained high pressure puffs that are independent of receiver capacity or compressor size. Also, because no air is emitted at ineffective low pressures, there's greater economy in *use* of cleaning medium.

Acceptable stack emission is achieved because intermittent air puff blowing eliminates more concentrated and objectionable emission caused by continuous blowing arcs or blowing puffs of longer duration. In the standard Diamond Air-Puff System, intervals between air puffs are determined by the time required for build-up to optimum blowing pressure; however, if more positive control of stack emission is desired, intervals can be regulated by a simple valve adjustment.

The Diamond Air-Puff Blowing System for new *or* existing boilers of any type and capacity is further evidence of why "Diamond developed" means more economical power. Our engineers will be happy to discuss its application to your units. Call, write or wire for complete information . . . and thank you for reading our advertisement.

DIAMOND POWER

This is the new trademark of Diamond Power . . . a symbol of quality, integrity and progress . . . in products, systems and service.

DIAMOND POWER SPECIALTY CORPORATION, Lancaster, Ohio
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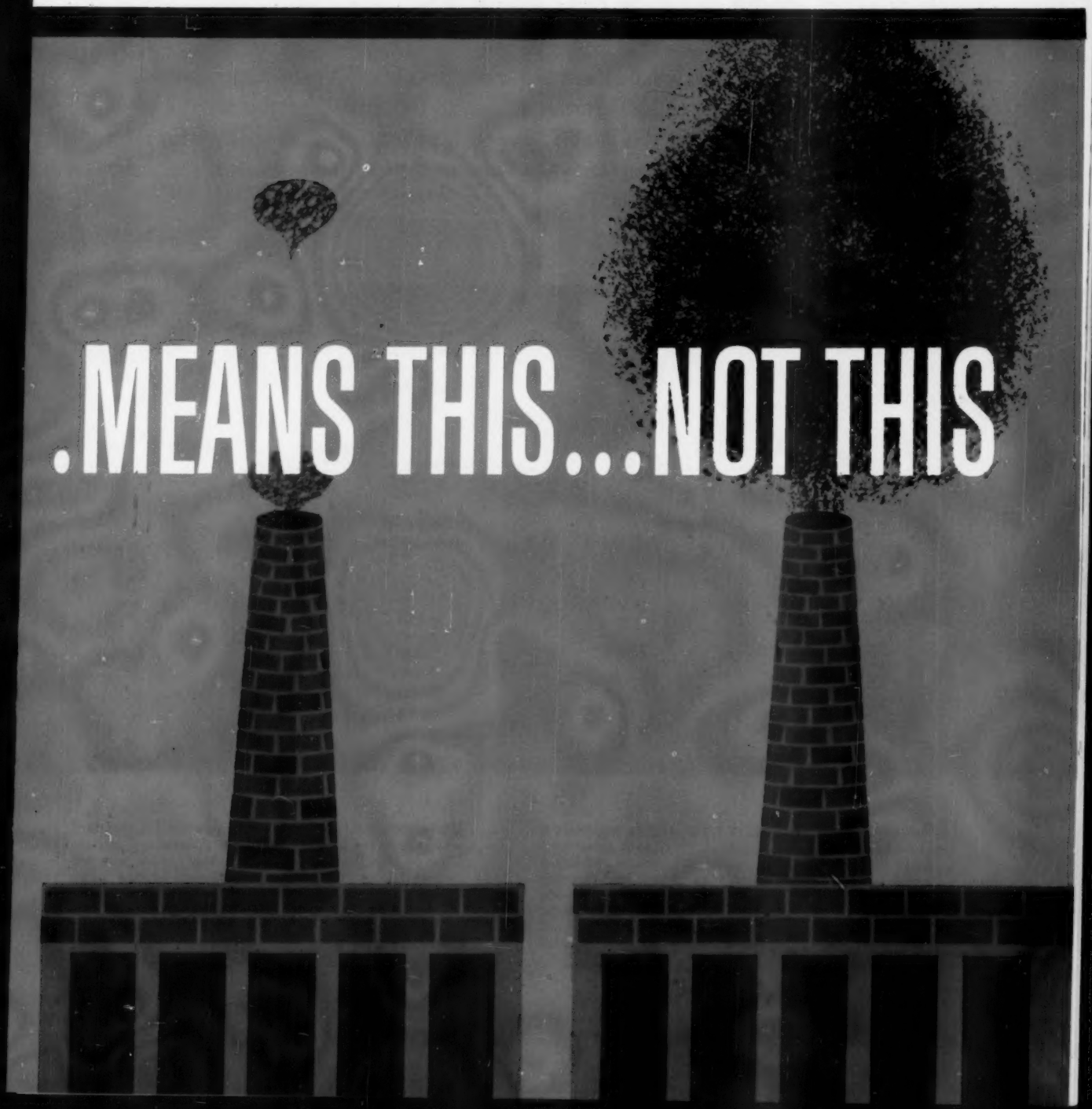
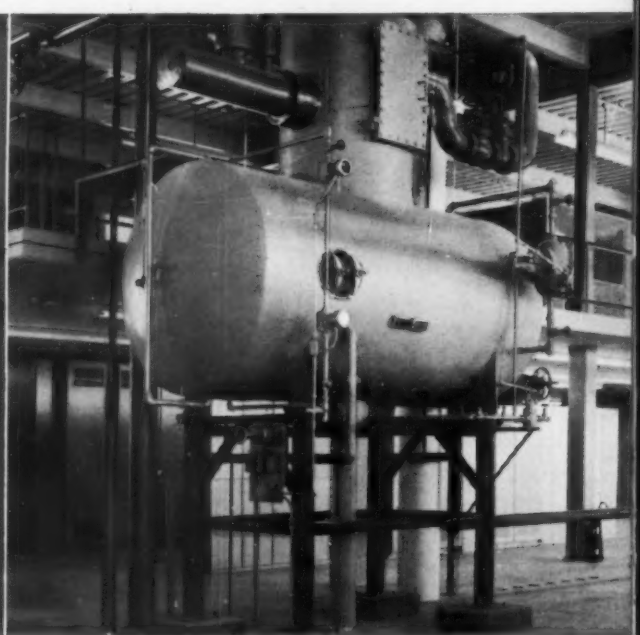


Current news reports

WHAT'S HAPPENING IN POWER SERVICES?

Highlights: Switchgear with the lowest silhouette on the market. A "guided flow" condenser that slashes space requirements. These examples demonstrate the extra value that is standard with Allis-Chalmers . . . the greater efficiency and the added productivity that are yours when you buy A-C products, systems and services. Call your nearby Allis-Chalmers office for details or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.



Rugged construction for continuous operation at highest possible efficiencies — yours with these condenser circulating water pumps and vertical induction motors. All pumps are tested at rated head and capacity to assure guaranteed performance. Available in a wide variety of materials to meet your installation needs. *Super-Seal* motors, with *Silco-Flex* insulation, assure complete reliability for outdoor installations and areas with high humidity or contaminated atmospheres.

Stainless steel "scorns" corrosion — It's standard with all Allis-Chalmers tray-type deaerator internals. This 90,000 lbs. per hour "package" unit removes oxygen and other corrosive gases besides heating boiler feedwater. Heating and distributing tray design provides greater spillage edge — extra-efficient air separating trays remove more oxygen and gases through full counterflow design. Protects boiler and associated steam and condensate equipment from corrosive attack.

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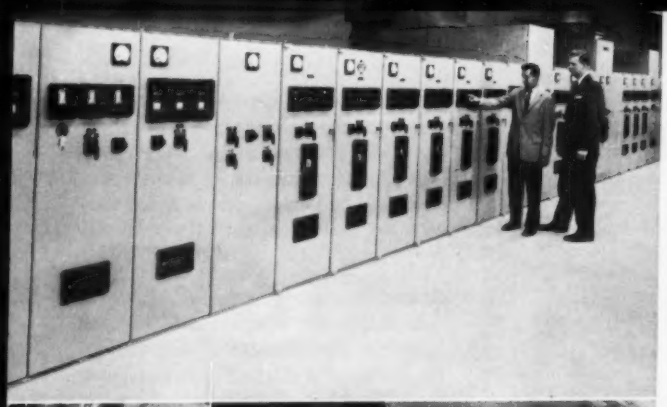
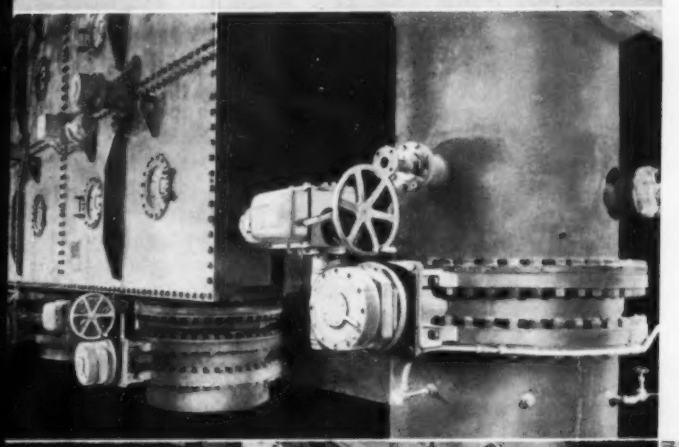
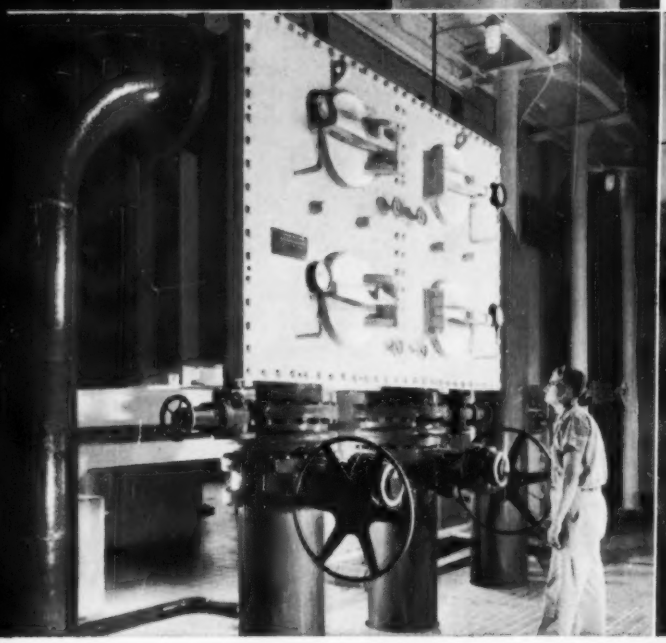
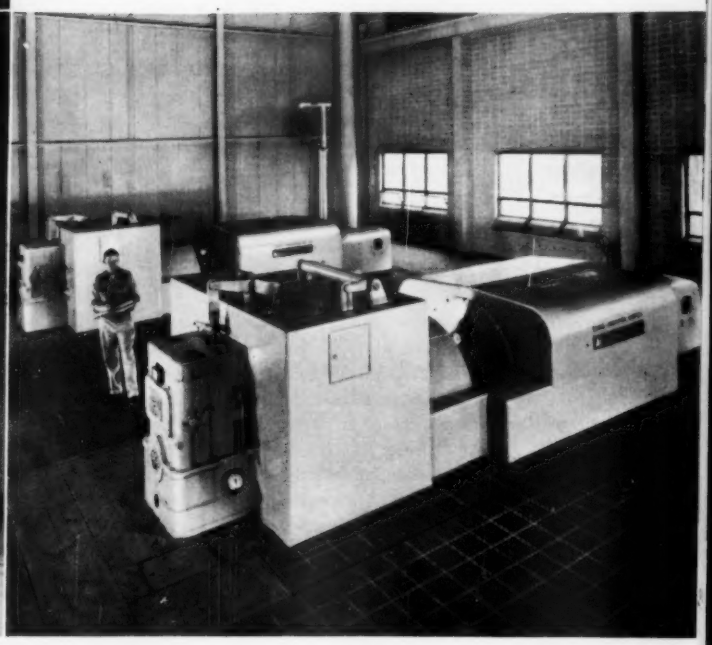


Lowest height, easiest access 5-kv metal-clad switchgear on the market. Just 72 inches high, you get eye-level instrumentation, shoulder-height accessibility of component parts. Other outstanding advantages: front-accessible current transformers; maximum compartmentation and dead-front construction for greater safety; full-panel metering; rapid, one-stroke breaker insertion. Choice of stored energy or solenoid operated circuit breakers.



Eliminate tuberculation and oxidation, reduce maintenance with rubber-seated butterfly valves. Operation is always extra-smooth and easy with 100% effective shutoff. Full body protection is offered by a rubber seat that extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly. Being light and compact, these valves require less space and support than most other types.





Extra-compact rectangular steam condenser shape reduces space requirements. "Guided-flow" design achieves highest efficiency and vacuum with available water temperatures . . . gets maximum temperature condensate at the hotwell. Internal reverse-flow design for cooling water effectively backwashes debris, ends costly shutdown, conserves space, requires no additional piping. Planned-as-a-package auxiliary condenser equipment also available.

Two non-condensing, automatic extraction steam turbine-generator units (3000 kw) — for a hospital center where extraction and exhaust steam are used for heating and other services. You get the advantages of two steam pressures — high pressure by automatic extraction and low pressure from the exhaust. Use of pressure-reducing valves and desuperheaters is minimized where a wide range of process pressures is desired.

Super-Seal and Silco-Flex are Allis-Chalmers trademarks.

ALLIS-CHALMERS

A-1479

HELPFUL WATER CONDITIONING DATA FROM BETZ

WATER . . . IN AIR

Failure of equipment and excessive maintenance costs will result unless proper methods of chemical feed and control are employed

AIR CONDITIONING is a development of this modern age that pays for itself. The trend for air conditioning continues upward at a rapid rate. Theaters, department stores, practically all kinds of commercial establishments and public buildings have adopted air conditioning for comfort. The trend toward industrial air conditioning is also on the rise. In earlier years, only those industries that required close control of temperature and humidity for product quality adopted air conditioning. Now, however, the desire to maintain employee efficiency, as well as production efficiency are additional factors that make air conditioning a wise investment. Achieving the benefits of air conditioning, and assuring payout on this investment is largely contingent upon one important factor—water.

Initially, little attention was given to the water used in air conditioning systems. However, it was soon found that water plays an important role in the proper functioning of air conditioning systems. The system piping, the heat exchangers, and all parts exposed to water may be affected by corrosion, by scale or sludge accumulation and by slime formation. These problems can lead to the loss of heat transfer, restriction of water flow, inefficient operation and excessive maintenance costs; or in severe cases to failure of the equipment and high replacement costs.

Water Circuits

Air conditioning installations are so varied as to components that a number of water circuits are possible. Figure 1 illustrates a simplified flow sheet of a central air conditioning system used in large installations. The three water circuits encountered are the chilled water which is in a closed circuit, the spray water which serves the air washer and the tower water which serves to condense the refrigerant. Figure 2 illustrates a simplified diagram of a small air conditioning system served by a reciprocating compressor and an evaporative condenser. The only water circuit is in the evaporative condenser. Although there are many types of arrangements possible, each of the water circuits must be given proper consideration to avoid serious problems.

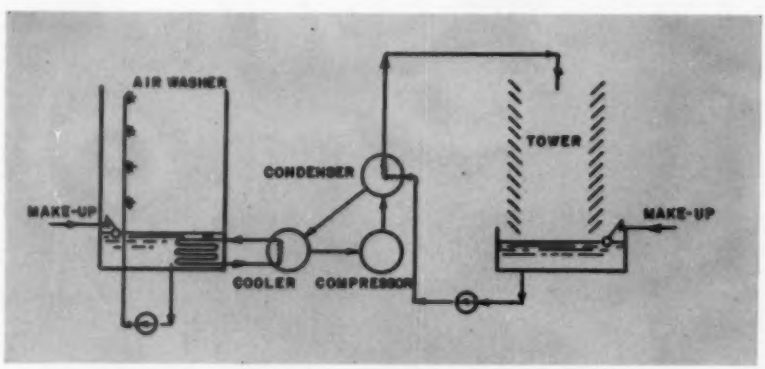


Figure 1—Simplified flow sheet of a central air conditioning unit with a closed chilled water circuit.

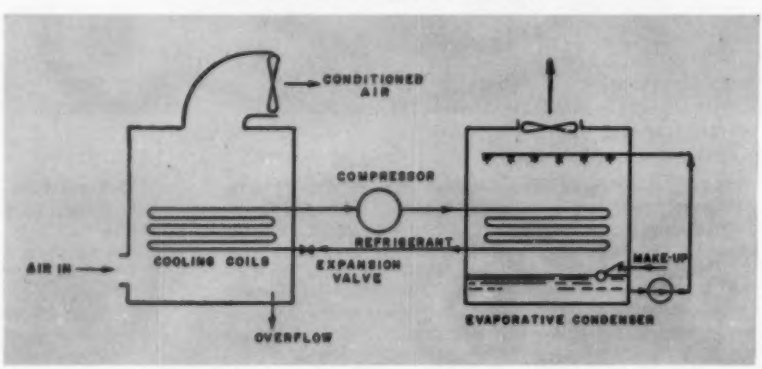


Figure 2—Simplified diagram of a small air conditioning system with one water circuit.

Water Problems

Corrosion

Most waters are corrosive to metals because of the presence of oxygen in the water. In air conditioning systems the water comes in contact with large volumes of air and therefore the water is continuously saturated with oxygen. Often the air may be contaminated with other corrosive gases such as sulfur dioxide and carbon dioxide which are present in flue gases discharged from smokestacks. These gases dissolve in water to form acids. The combination of dissolved oxygen and the acid formed from sulfur dioxide causes a particularly severe corrosion problem. Other factors, such as the presence of dissimilar metals, high concentrations of dissolved mineral salts—particularly chlorides, deposits of slime, scale, dirt, etc. all add to the corrosive action of the water.

Scale

In areas where the water is high in hardness, scale formation frequently is the principal problem. The calcium and magnesium salts naturally present in the water are primarily responsible for scale formation. If large amounts of these salts are present in the water, they will form deposits when the water is heated or concentrated by evaporation. The major problems produced from such deposits are loss in heat transfer, increased head pressures and clogged spray nozzles, all of which result in loss of efficiency.

Scale formation usually refers specifi-

cally to the deposits formed from the calcium and magnesium salts. Other deposits such as slime, corrosion products, dirt and debris, however, can produce the same adverse effects.

Slime and Algae Growths

Slime and algae growths in air conditioning equipment are primarily the result of air-borne organisms. The large ratio of air to water in air washers, evaporative condensers and cooling towers, provides the opportunity to continuously inoculate the water with bacteria, fungi and algae. Heavy growths can develop in the presence of an adequate food supply and the favorable temperatures that exist in these systems. These biological growths can seriously interfere with heat transfer, clog spray nozzles and screens as well as cause corrosion. Growths of this type cause inefficient operation of the mist eliminator section in air washers and lead to

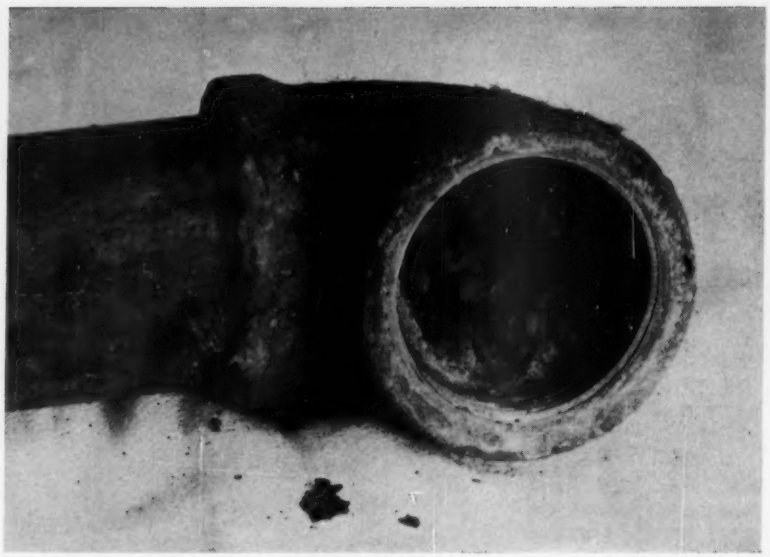


Figure 3—A section of piping from an air conditioning system showing the damaging effects of corrosion.

CONDITIONING

"water throw" into the duct work and out into the air conditioned area. Stagnant water in the ducts, and biological growths in general can impart foul odors to the air.

Treatment of the Water Circuits

Corrosion is the primary problem encountered in most air conditioning systems. The manufacturers and designers of air conditioning equipment recognize the seriousness of this problem and whenever possible employ materials of construction and design features that will minimize corrosion. They also recognize, however, that a continuous and well-controlled program of chemical treatment for the various water circuits is essential to assure maximum efficiency and life of the equipment.

The treatment of the water used in air conditioning systems does not represent an unusual challenge from the chemical standpoint. The problems of corrosion, scale formation and biological fouling are essentially identical to those encountered in most large industrial cooling water systems, for which effective and economical treatments have been developed and successfully applied. The primary difference exists in the spray water employed in the air washer which serves the dual function of cooling and dehumidifying the air in the summer and heating and humidifying the air in the winter. During the dehumidifying cycle, moisture is condensed from the air and becomes part of the spray water and this water eventually approaches the characteristics of the condensed moisture. During this cycle corrosion is the primary problem. During the humidifying cycle the moisture added to the air comes from evaporation of the spray water and as a result the spray water tends to concentrate and the dissolved salts, particularly those of calcium and magnesium may lead to scale formation. The volume of water in the air washer—particularly when a closed chilled water system is employed—is quite small compared to the large volume of air handled. As a result the characteristics of the water in the washer can change quite rapidly. In addition, the inoculation of the water with air-borne bacteria, dust, lint, and corrosive gases intensify the problem. The true challenge is not the complexity of the chemical treatment problem, but the *application and control* of the treatment to handle the constantly changing conditions. In most cases, the failure of chemical treatment has been the direct result of improper methods of application or inadequate control.

Application of Treatment

Proportional feed of treatment and continuous blowdown of air conditioning units are mandatory if good results are to be secured. Automatic, trouble-free feeding equipment has been designed to handle the rapidly changing conditions encountered in air conditioning units. The application and control of treatments for prevention of corrosion, scale and biological fouling has been greatly simplified.

The Betz approach for treatment and control of air conditioning water problems will assure protection of your investment and make air conditioning a plant facility that pays for itself. For more details on automatic, trouble-free proportioning of water treatment chemicals to air conditioning systems, write for Bulletin 597A.

BETZ LABORATORIES, INC.

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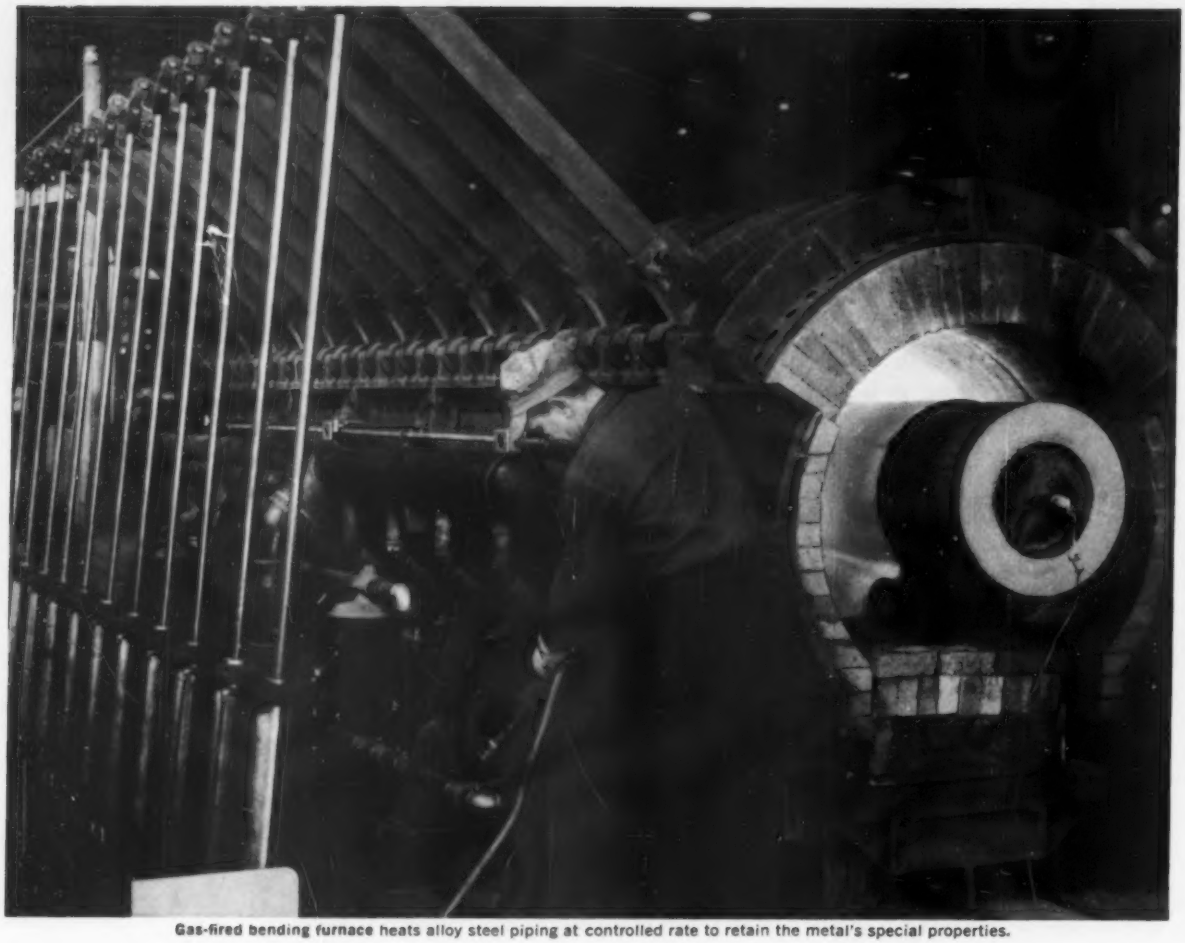
■ CONSULTANTS ON INDUSTRIAL WATER PROBLEMS



Gas-fired bending furnace heats alloy steel piping at controlled rate to retain the metal's special properties.

Grinnell shop-fabricated piping is 3 ways better than field-fabricated piping

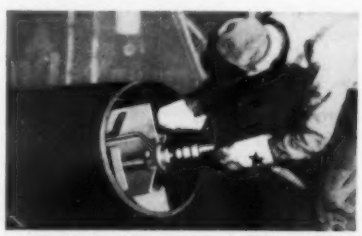
1. Strict quality control. Piping fabricated in the Grinnell shop is made under the strictest quality control . . . with the help of interpretive engineering, metallurgical research, skilled personnel, specialized facilities and rigid inspection at every critical step. Piping fabricated in the field is not made under these ideal conditions.

2. One-company responsibility. Shop-fabrication by Grinnell makes one experienced organization responsible for material procurement, engineering, fabrication and delivery. These many interrelated factors are kept in balance to give you quality at an economy price — no runaway costs.

3. Costs known in advance. With Grinnell, you know all costs — including shop sketches and planning, materials, power services, expendable tools and supplies — *before* you start the job.

Grinnell shop-fabricated piping always meets your exact specifications . . . whatever the size of the job. For your next piping installation, write: Grinnell Company, Providence 1, Rhode Island.

Special jigs and turntables allow Grinnell operators to weld from best positions, assuring superior weld quality.



Lagenda cleaning removes sand, scale, rust, weld spatter, other foreign matter from inside piping.

GRINNELL

Pipe Fittings, Valves, Pipe Hangers, Prefabricated Piping, Unit Heaters and Piping Specialties
Branch Warehouses and Distributors from Coast to Coast

For more data circle 512 on Post Card

This compact Package Air Preheater is being installed on a 150,000 lb/hr boiler at Olin Mathieson Chemical Corp.'s Brandenburg, Kentucky, petrochemical plant. When in operation it will recover enough heat from the boiler exhaust to increase efficiency of the boiler between 8% and 9%.

OLIN MATHIESON RECOVERS 360°F FROM BOILER EXHAUST WITH 11½′ x 11′ x 8′ PREASSEMBLED LJUNGSTROM® PACKAGE AIR PREHEATER

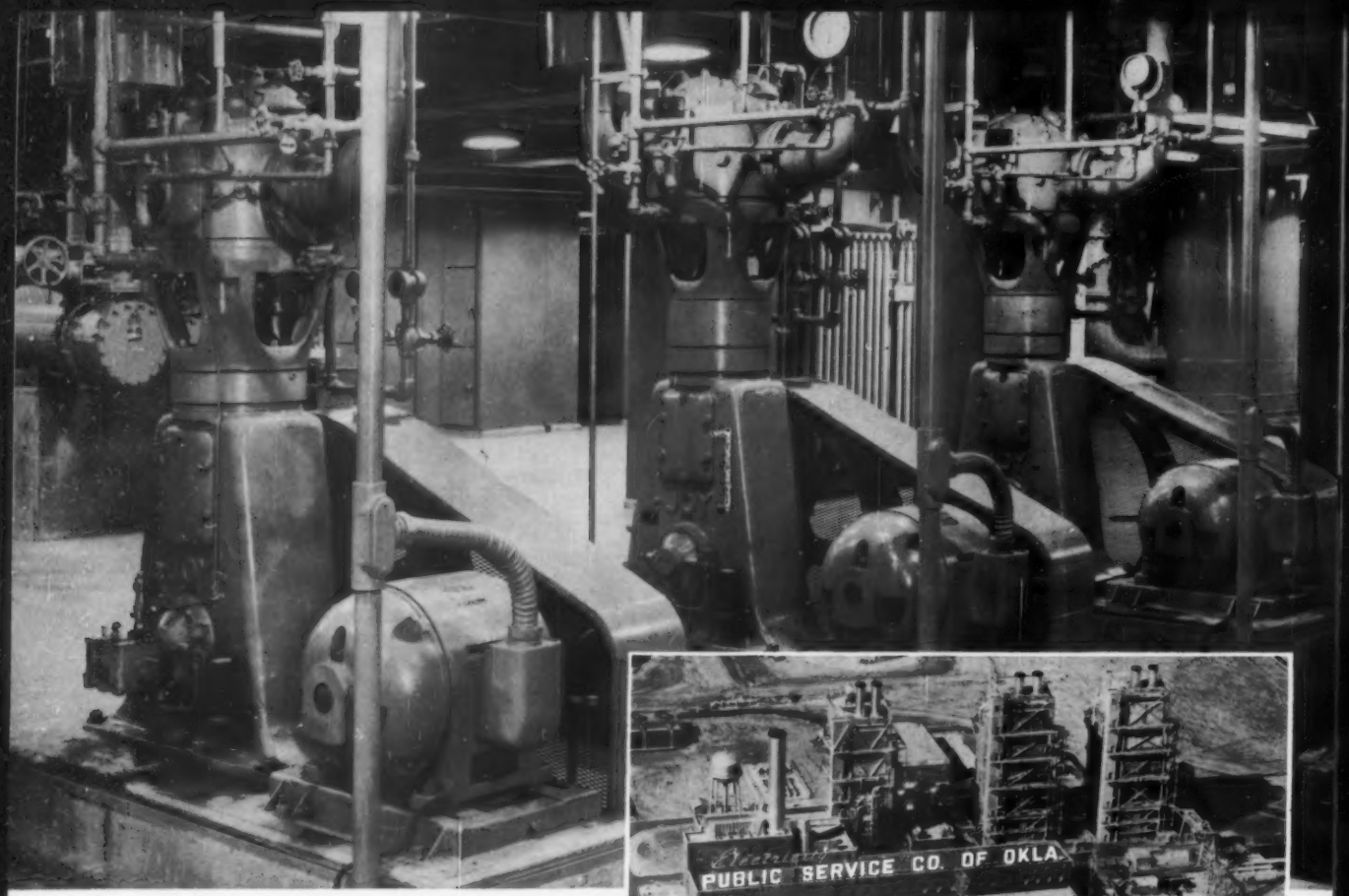
Olin Mathieson specified a Ljungstrom Package Air Preheater because it saves space as well as fuel. Mathieson's Ljungstrom occupies only about 1000 cubic feet, but cuts boiler exhaust temperature from 680°F to 320°F — puts 360° of heat back to work in the boiler.

The compact preassembled Package Air Preheater is ready to run when it's delivered—just connect to the power line and ducts, and it's on-stream. You make big savings on installation because there's no on-the-spot erection.

You can use a Ljungstrom Package Air Preheater on boilers from 25,000 to 250,000 pounds of steam per hour. For more information, write today for your free copy of a 14-page booklet.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.



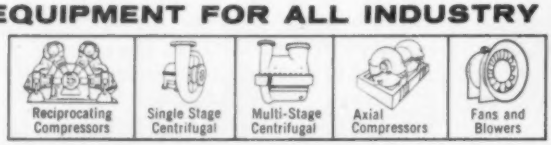
Two Joy WGOL-9 Compressors supply oil-free air for instrumentation on 175,000 KW generator-turbine unit at PSC's Tulsa Station. Third machine is a Joy WG-9 standard construction compressor for plant air.

Good experience with earlier machines prompts Public Service Co. of Okla. to install third group of Joy compressors since 1955

When the ultra-modern Northeastern Station of Public Service Company of Oklahoma goes on the line in 1961, both instrument and plant air will be provided by a battery of Joy Compressors. Two WGOL-9 machines will supply oil-free air, and two standard construction WG-9's will provide the plant air. These machines represent the third order for Joy's vertical type compressors in six years—evidence that this progressive utility has had good results from the earlier purchases.

The Joy WG-9 Vertical Compressors are particularly well suited for generating station applications. They offer heavy duty compressor features such as force-feed lubrication, replaceable cylinder liners and crosshead guides and heavy frame construction, yet their size and capacity range makes them economical for power plant service. Oil-free and standard air machines are almost identical in construction, which facilitates maintenance. Consult your Joy representative the next time you are expanding your air supply. He can furnish reliable oil-free or standard air compressors from 15 to 1250 hp. For complete details on the Joy WG-9 and WGOL-9 Compressors, write for Bulletin 2552-56C.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



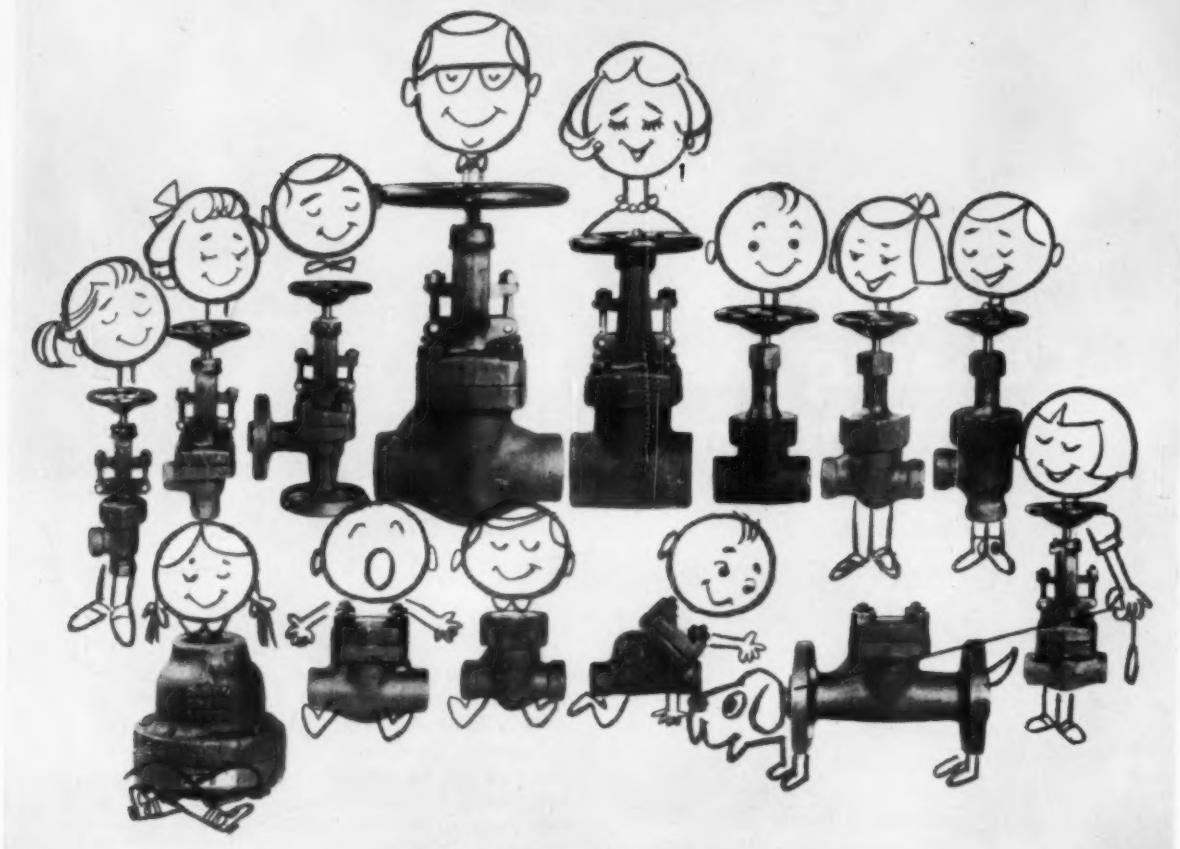
JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

For more data circle 514 on Post Card

CRANE'S LARGE FAMILY OF SMALL STEEL VALVES



CRANE 600-POUND STEEL GATE, GLOBE, ANGLE AND CHECK VALVES—¼" TO 2" SIZES—

gathered together for their first family portrait, from thousands of flow control assignments in every industry. In forged and cast steel; bolted and union bonnets and caps; outside screw and yoke or inside screw; Exelloy, Stellite*, Type 316 Stainless, Monel trims; reduced and full ports; screwed, flanged and socket-welding ends—one or more will meet every specific need. All share the Crane family trait of superior design, ruggedness and fine craftsmanship.

*Stellite is a registered trademark of Union Carbide Corp.

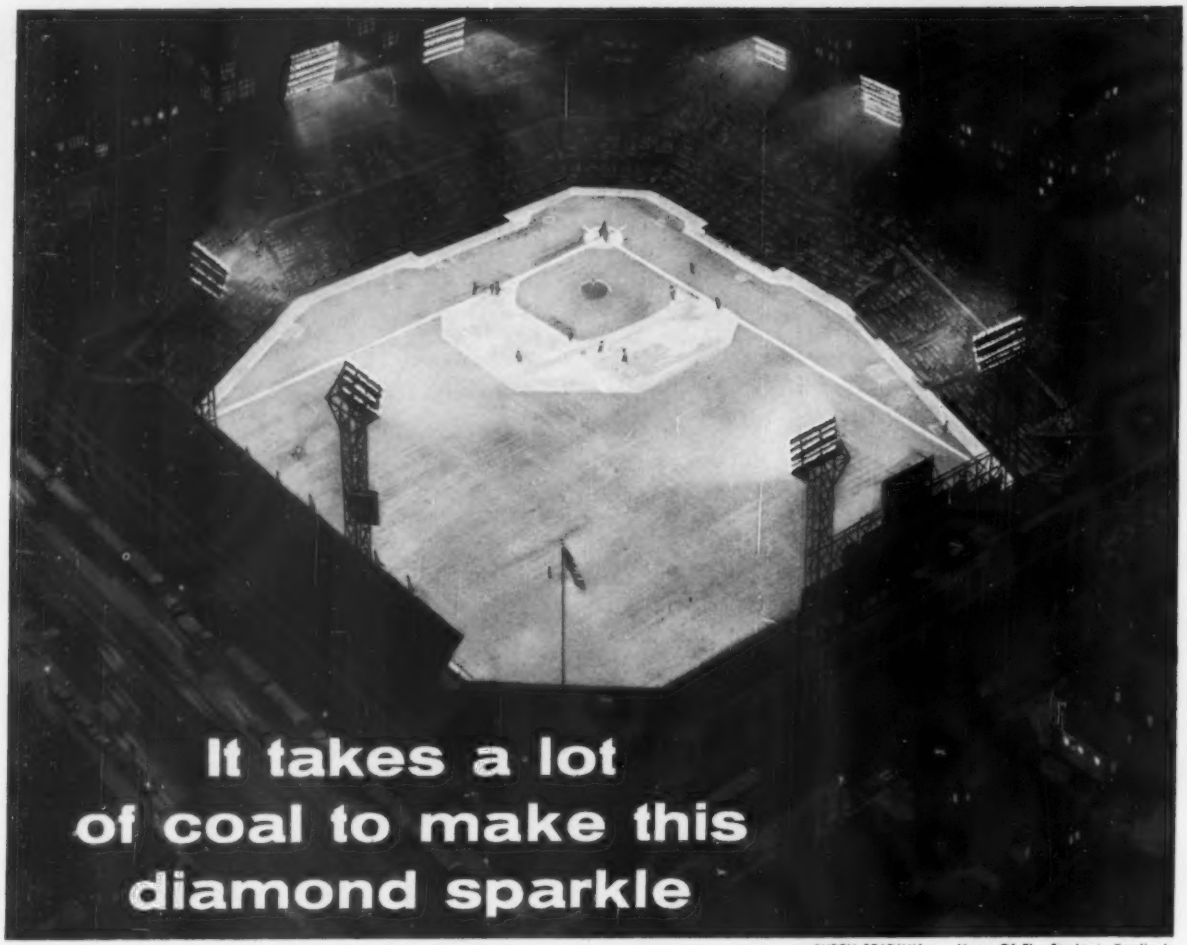
at the heart of home and industry

CRANE

valves
piping • electronic controls
plumbing • heating
air conditioning

For complete details contact your Crane Distributor, or write: Crane Co., Dept. J Industrial Products Group, 4100 So. Kedzie Ave., Chicago 32, Ill. In Canada: Crane, Ltd., 1170 Beaver Hall Square, Montreal.

For more data circle 515 on Post Card



BUSCH STADIUM . . . Home Of The St. Louis Cardinals

For an Average Night Game, Union Electric of St. Louis Uses About 6,000 Pounds of Coal to Generate the Electricity That Lights Busch Stadium

The electricity that lights Busch Stadium is generated principally by coal, and Peabody is one of Union Electric's major suppliers. In our homes, offices, plants . . . even at the baseball games . . . coal serves us by generating dependable, economical power. In fact, one of the primary reasons for the continued low cost of electricity is the stabilization of coal prices—a direct result of big, fully mechanized mines such as those operated by Peabody. Not so strange then, that coal generates more electricity than all other fuels and water power combined.

Peabody Coal Company . . . with over two billion tons of proven reserves . . . supplies coal to many of the nation's leading Electric Utilities that furnish you this power . . . at a price you can afford to pay. The next time you watch a night baseball game . . . at the ball park or on your television set . . . think of *coal* and the great Electric Utilities that help make it possible.

If you are seeking a new plant site, Peabody can be of assistance to you. Contact us for information on strategic industrial locations. No obligation, of course! Call today or write Department PE.

power for progress

PEABODY COAL COMPANY

Peabody Plaza • 301 Olive Street • St. Louis 2, Missouri

Offices In: Chicago, Columbus, Des Moines, Detroit, Indianapolis, Kansas City, Louisville, Madison, Wis., Memphis, Minneapolis

For more data circle 516 on Post Card

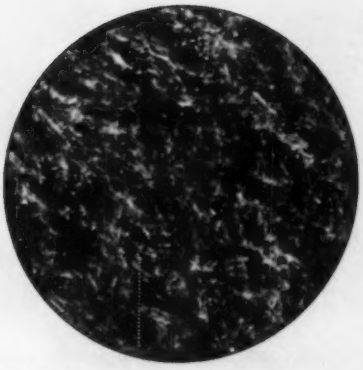
IT'S THE INTERLOCK THAT MAKES MONO-BLOCK®

It's no wonder that hundreds of industries' leaders specify Baldwin-Ehret-Hill Mono-Block for their medium and high temperature block insulation requirements, up to 1800 F.

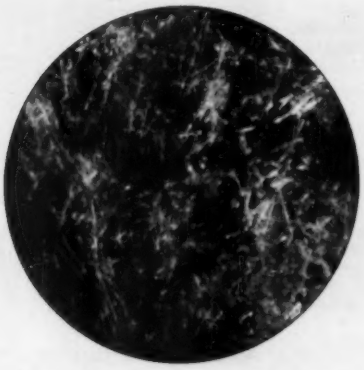
The reason? An exclusive Baldwin-Ehret-Hill manufacturing process assures that the fine mineral wool fibers used in Mono-Block are completely and thoroughly dispersed in a liquid slurry and thereby interlocked to provide the highest strength. Further, this interlocking process means that Mono-Block will cut cleanly and conform to irregular surfaces, such as lap or butt welds, etc., without tearing or breaking.

Another reason for Mono-Block's leadership is its high strength, minimizing loss due to breakage. And the tough, strong surface of Mono-Block can be directly finished with Baldwin-Ehret-Hill No. 1 or Super Powerhouse Cements in many instances without the need for applying wire mesh.

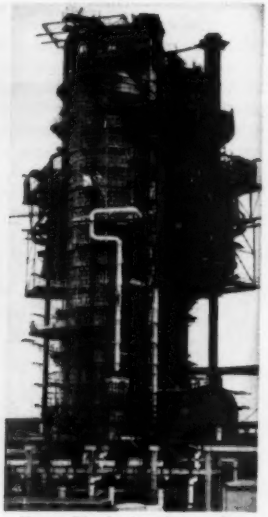
For detailed information about Mono-Block or any of the complete line of industrial insulations manufactured by Baldwin-Ehret-Hill, and the name of your nearby B-E-H qualified contractor, write to Department M-B, Baldwin-Ehret-Hill, Inc., 500 Breunig Ave., Trenton 2, N. J.



B-E-H Mono-Block magnified 10 times to show uniform, interlaced structure resulting from interlocked fibers.



A commercially available block product equally magnified to show the uneven texture.



Mono-Block insulates the world's largest catalytic cracking unit for Tidewater in Delaware.

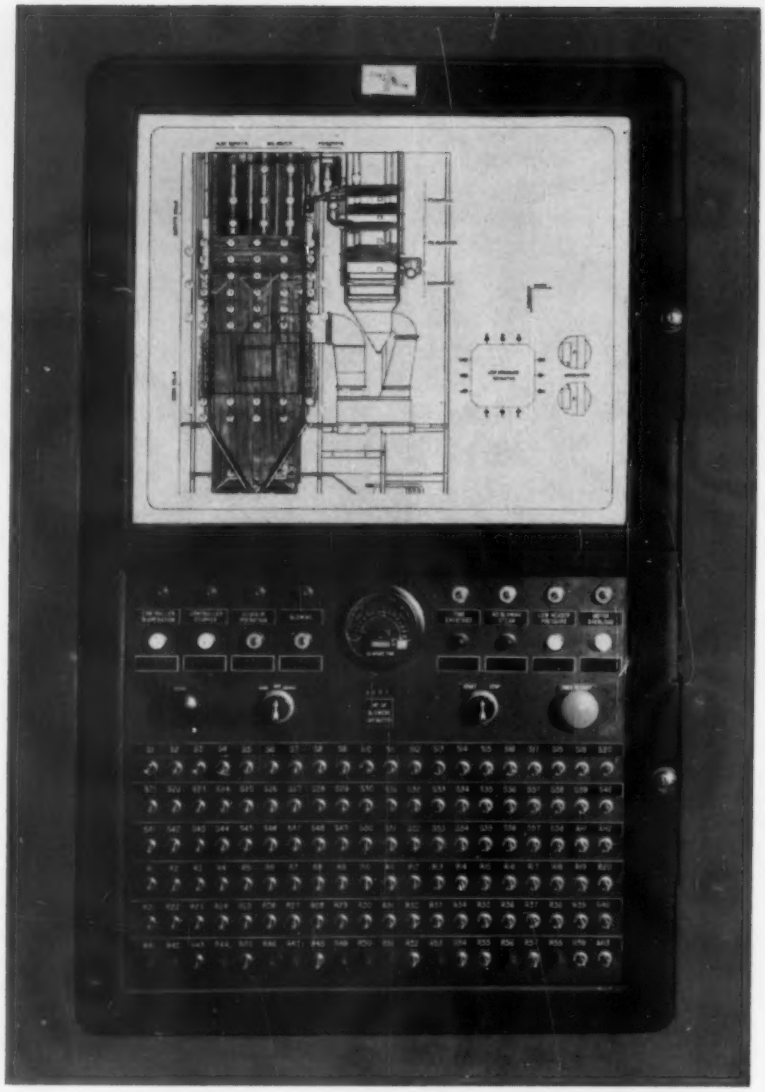
B E H
BALDWIN-EHRET-HILL

Baldwin-Ehret-Hill manufactures a complete line of mineral fiber, calcium silicate, 85% magnesia and polyurethane industrial insulation products, including pipe insulation, blocks, blankets, felts, cements and loose fill for sub-zero to 1900 F service.

BALDWIN-EHRET-HILL, INC.

Trenton **New Jersey**

For more data circle 517 on Post Card



Selective-Sequence Controller

Up to 120 electrically-driven long retractable Vulcan soot blowers can be controlled by this SSC-120 controller. With it the operator can monitor the complete blowing program and get an instant report should there be any malfunction. In such case, interlocks automatically stop the blowing until a correction is made.

Vulcan Selective-Sequence control offers the greatest flexibility in automatic soot blowing. It permits varying the sequence by individual blowers — at any time, and in any way found desirable to improve boiler cleaning or to save blowing medium. Tied to a built-in clock, it permits 24-hour scheduling with three or more sequences.

Vulcan Automatic-Sequential Control permits the operator to pre-select any number of units to be operated individually — not necessarily by zones or bands. Without leaving the panel he can revise the sequence at any time, or switch instantly to single-unit operation.

Both control systems are described in Bulletin 1029. Write for it.

With either system: A new console-mounted miniature panel provides even greater convenience and efficiency. Soot blowing may be tied to some such phase of boiler operation as steam temperature control, a refinement with which Vulcan has had more than six years of experience. And for the ultimate in soot blower control, the Vulcan system can be tied in with computer operation of the plant.

Vulcan "Automated" Soot Blowing

Modern boilers must be kept clean to operate efficiently—but the cleaning itself must be done efficiently to match modern operating procedures.

Vulcan precisely-controlled automatic soot blowing systems meet this specification.

They save time. One blower automatically follows another as programmed. Indexing is a matter of seconds.

They save labor. Merely pushing a button starts automatic operation. The operator or computer controls the whole system from one central location.

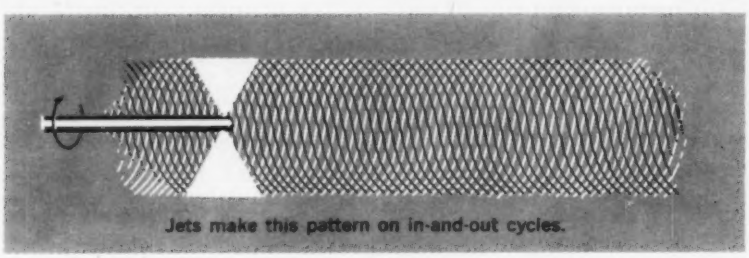
They save fuel. Cleaning is better because operation is positive and at proper intervals. Steam—which means fuel—and air are saved because of precise timing.

T-30 Mark I-E Long Retractable

Long Retractable Soot Blowers

The electrically-driven T-30 Mark I-E is the most modern long retractable soot blower for travels up to 24 feet. It has dual-motor drive. One motor moves the lance in and out. This can be a 2-speed motor to save blowing medium. The other rotates the lance—always in the same direction. The special-alloy lance can be used in almost any temperature. Low rotating speed increases range and penetration of cleaning, decreases wear, and eliminates whip. Write for Bulletin 1063. The T-30 Mark I-A, Bulletin 1073, is air-driven. For travels greater than 24 feet, the Vulcan T-30, Bulletin 1030, is used.

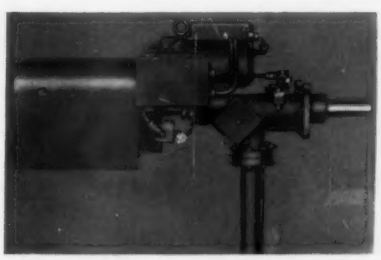
Rotary Soot Blowers with electric, air or manual operation are available for use in lower-temperature zones. Write for Bulletin 1072.



Jets make this pattern on in-and-out cycles.

Vulcan RW-3E Wall Deslagger

The high striking power of this electrically-operated deslagger drives off gummy, clinging masses or sintered ash to minimize average slag thickness. One motor extends and retracts the lance almost instantly. The other motor rotates the lance slowly for optimum cleaning. Air, saturated or superheated steam, or water—or any combination—can be used as the blowing medium. Blowing pressure may be adjusted while blowing. Maintenance is easy. Write for Bulletin 1034. Model RW-3A is air-driven. Write for Bulletin 1066.



Multi-Helix Jet Path

Because Vulcan long retractables have dual-motor drive, lance rotation is continuous with no stop-step action at the end of travel. The two jets always follow a different path in and out, forming an infinite number of reversed-helix paths on repeated cycles. This means thorough cleaning of all heating surfaces, minimized danger of tube erosion, and prolonged packing life.

saves time, saves labor, saves fuel

And maintenance is low. Each component of a Vulcan system is designed with maintenance men in mind.

Write for the bulletins mentioned on these pages. Copes-Vulcan Division, Erie 4, Pennsylvania.

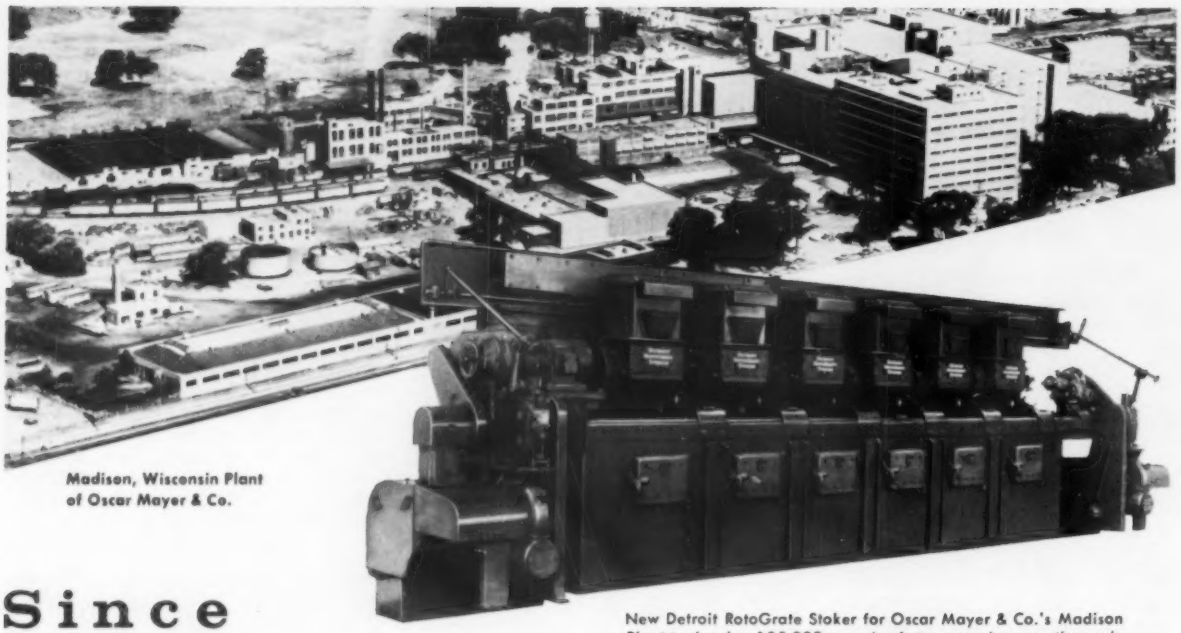
Copes-Vulcan Division

BLAW-KNOX

BLAW-KNOX

Blaw-Knox designs and manufactures for America's growth industries: METALS: Rolling Mills • Steel Processing Lines • Rolls • Castings • Open Hearth Specialties • PROCESSING: Process Design, Engineering and Plant Construction Services • Process Equipment and Pressure Piping • CONSTRUCTION: Concrete and Bituminous Paving Machines • Concrete Batching Plants and Forms Gratings • AEROSPACE: Fixed and Steerable Antennas • Radio Telescopes Towers and Special Structures • POWER: Power Plant Specialties and Valves

For more data circle 518 on Post Card



Madison, Wisconsin Plant of Oscar Mayer & Co.

New Detroit RotoGrate Stoker for Oscar Mayer & Co.'s Madison Plant to develop 125,000 pounds of steam per hour continuously for 24 hours—150,000 pounds for peaks, when burning Indiana coal, 10530 BTU per pound, 13.25% ash, A. F. T. 1900° F. Helmick and Lutz, Minneapolis, Consulting Engineers.

Since 1938

Detroit Stokers have served Famous Sausage Makers with Economy . . . High Availability . . . Low Maintenance

Oscar Mayer & Co., pioneer meat processing firm, has been making sausages since 1883. By stressing quality and uniformity of product, it has grown from a small meat market on the near-north side of Chicago to the nation's 9th largest producer with sales last year of $260,000,000.

In 1938, the company installed a Detroit RotoStoker in the Madison, Wisconsin, plant. Purchase of a plant in Davenport, Iowa, brought them another RotoStoker in 1941.

These served so well that in 1947, they bought a Detroit RotoGrate Stoker for the Madison plant as a part of an expansion program.

When more expansion was planned in 1959, they bought two more RotoGrates, one each for the Madison and Davenport plants, making a total of five acquired since 1938.

Detroit RotoGrate is an overthrow spreader stoker with traveling grates that move slowly forward, discharging ash at the front. Suitable for boilers up to 400,000 pounds of steam per hour capacity . . . it burns any bituminous coal or lignite and many types of refuse, separately or in combination with coal. It is one of the complete line of Detroit Stokers for small, medium and large boilers.

DETROIT STOKERS COST LESS

DETROIT SINCE 1898 STOKERS

Cost equals initial investment plus upkeep, plus production losses due to equipment outage. *The total is less with Detroit.*

DETROIT STOKER COMPANY
DIVISION OF UNITED INDUSTRIAL CORPORATION
MAIN OFFICE AND WORKS • MONROE, MICHIGAN
District Offices or Representatives in Principal Cities

For more data circle 519 on Post Card

Current Catalogs

Pumps, Compressors

101 Packaged Pumps—Bulletin 117 PKG introduces close-coupled end-suction centrifugal pumps of Aurora Pump Div., The New York Air Brake Co. Sectional views, specifications, performance charts and dimensions point up compactness, design simplicity, space savings, easier installation.

102 Seal-less Pumps—Design, operation and selection of canned pumps for leakproof pumping of corrosive, toxic, volatile, explosive, radioactive or other fluids is covered in Fostoria Corp.'s Bulletin 1100-1. Standard specification data is included along with other information.

103 Flexible Process Pumps—Eight-pp Bulletin 1-210 of Byron Jackson Pumps, Inc. describes process pumps featuring maximum interchangeability of parts and shows 72 basic combinations to meet every requirement.

104 Single-Stage Compressors—Included in 18-pp Bulletin P-13, by Elliott Co., is detailed information on single-stage compressors, including diagram of lubrication system, data section and performance calculations.

105 Heavy Duty Compressors—Performance details and basic construction features of Joy Mfg. Co.'s heavy duty air compressors for continuous operation are detailed in 36-pp Bulletin A-43, with dimension tables and fold-out drawings and dimensional diagrams included.

106 Compressor Valve Story — Operation and importance of valves in modern reciprocating compressors are described in 44-pp Booklet Form 3222 by Ingersoll-Rand Co. Question and answer format details demands made on valves and their function in a compressor. Ingersoll-Rand Co. traces evolution of valving from 18th century types to present high-speed models.

Mechanical Power Transmission

107 Variable Speed Drives—Included in this 112-pp catalog on integral and fractional horsepower drives by Sterling Electric Motors, Inc., are selection tables, cutaway drawings and illustrations of modifications, including single, double, and triple reductions, horizontal, single and double worm assemblies. Price section covers 2:1 to 6:1 variations and maximum variations.

108 Flexible Couplings—Specifications and capacity data for power drive flexible couplings are provided in Bulletin J-23 of Jones Machinery Div., Hewitt-Robins. Couplings described include double engagement, mill motor, single engagement, standard double engagement, extended, standard mill, standard mill motor, standard single engagement, others.

Valves, Traps, Piping

109 Safety and Relief Valves — Comprehensive performance and selection information on safety and relief valves for industrial applications is presented by Manning, Maxwell & Moore, Inc. in 144-pp Catalog 700B. Includes capacity and dimension tables, specifications, diagrams and charts on cast steel, cast iron safety and relief valves, Maxiflow safety valves, electromatic relief valves, bronze valves. Available to qualified power engineers, please state your job title.

110 Semi-Steel Valves — Illustrated and described in 44-pp Bulletin V-203 by Rockwell Mfg. Co. are semi-steel straightaway, steam jacketed, multiport and special valves. Includes specifications and dimensions, and describes accessories such as wrenches, locking devices, extensions, lubricants.

111 Silent Check Valves — Results of pressure loss tests conducted on flanged silent check valves of The Williams Gauge Co., Inc. are presented in tabulated Bulletin WH-659, along with pressure drop information.

112 Flanged Check Valves — Features and advantages of flanged silent check valves with removable disc and seat are detailed in Bulletin WH-654 by The Williams Gauge Co., Inc. Dimensional data included.

113 Traps and Strainers—A handy working tool, 24-pp Catalog 400 of W. H. Nicholson and Co. provides streamlined data on thermostatic and expansion steam traps and strainers. Covers function, operation, typical applications. Features new trap sizing method and covers selection of traps for steam service, air and liquid heating, direct, indirect steam contact heating.

114 Pipe Dimension Chart — For desk or wall mounting, this chart published by Midwest Piping Div., Crane Co., shows outer diameter and wall thickness for pipe from ½ through 42 in. Includes information on ASA Standard B36.10, showing IPS and schedule numbers and their relationship.

115 Improved Pipe Hanger — Features and advantages of a pipe hanger with spring retainer ring which eliminates welding are detailed in Form 2594 by Blaw-Knox Co. Load range-deflection tables included.

Heat Exchangers

116 Block Heat Exchanger — Featured in 8-pp Catalog Section S-6813 by National Carbon Co., Div. Union Carbide Corp. is an impervious graphite counterflow block heat exchanger. Dimensional data and fluid flow patterns, as well as pressure drop characteristics are included.

117 Heat Exchangers, Aftercoolers—Eight-pp Bulletin 715 contains latest information on aftercoolers, and shell and tube type heat exchangers made by R. P. Adams Co., Inc. Design and operating details are covered and specifications included.

Instruments, Controls

118 Industrial Thermometers — Illustrated and described in 68-pp Catalog 100B by Manning, Maxwell & Moore, Inc., are mercury, vapor pressure and gas actuated dial thermometers, red mercury tubing industrial glass thermometers, and recording thermometers. Dimensional drawings and specifications are included.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 85 and 86.

119 Temperature Transmitter — A pneumatic temperature transmitter which uses a filled thermal system and transmits a standard 3-15 psi signal varying in proportion to changes in measured temperature is featured in 8-pp Specification S 630-1 by Minneapolis-Honeywell Regulator Co.

120 Improved Gages—Catalog DH-54, 32-pp, presents pressure vacuum and compound indicating gages of Helicoid Gage Div., American Chain & Cable Co., Inc. stresses long-lasting accuracy of the gages. Illustrates construction features and operation of Helicoid movement, also shows various types of cases, dials and movements. Includes how-to-order suggestions.

121 Precision Pressure Regulators—Features and advantages of pressure regulators—direct acting, reverse acting, control valves—are detailed by Manning, Maxwell & Moore, Inc., in 12-pp Bulletin 116. Flow coefficients for sizing valves for water and steam are included.

122 Load Cell Systems—Remote indicating load cell systems for force measurement applications are described by W. C. Dillon & Co., Inc., in 12-pp Bulletin R-2. Suggests imaginative ideas for new applications.

Current Catalogs

123 Combustion Controls—Eight-pp Bulletin 3-001, issued by The North American Mfg. Co., describes combustion controls for furnaces, ovens and boilers. Gas pressure and furnace pressure control, ratio control and flow control are discussed.

124 Miniaturized Electric Eyes — Bulletin 611, 22 pp, covering all phases of electric eyes in automation, is both "answer book" on problems and reference manual on photoelectric controls. Prepared by Photomation, Inc., shows diversified photoelectric systems, includes data on miniaturized light sources, photo units, electronic controls and timers.

125 Electronic Governor — Bulletin GEA-7231, General Electric Co., describes a speed and load-sensing governor offering accuracy, high response. Discusses operation and includes block diagram of the system.

126 Diesel Instrumentation — Presented in 12-pp Bulletin 1044 by Alnor Instrument Co. is detailed information on instruments and automatic controls for diesel and gas engines, including thermocouples, switches, pyrometers, limit controls, load balance monitoring system.

127 For On-Stream Analysis—Details on the Chemonitor, an instrument for continuous on-stream analysis of critical constituents in water, are presented by Hagan Chemicals & Controls, Inc. in this 16-pp brochure.

> When ordering catalogs, allow time for us to relay your requests to the manufacturers — and for them to mail out copies. Remember, manufacturers are often swamped with catalog requests.

128 Radioactivity Measurement Instruments — Illustrated and described in 96-pp Catalog S by Nuclear-Chicago Corp. are more than 250 instruments for radioactivity measurement, many of them recently developed products. Included are counting systems, ratemeters, portable survey meters, detectors, neutron generators, training instruments, radionuclides, shielding and nuclear accessories.

Safety, Fire Protection

129 Safety Belts—In Bulletin 1302-6, 8 pp, Mine Safety Appliances Co. describes belts, harnesses, straps and lanyards designed for comfort and protection against falls. Covers types of leather and webbing, tensile strengths, design adaptations. Highlights harness and suspension type belts.

130 Controlling Industrial Fires — Some 24 questions on fighting fires with high pressure fog are answered by John Bean Div., Food Machinery & Chemical Corp. in this 12-pp pocket-size booklet. Testimonials from users are included as well as descriptions of mobile and stationary fire equipment.

Welding, Hardfacing

131 Welding Pressure Lines—Twenty-pp Bulletin 2112.2 of Lincoln Electric Co. contains practical tips on techniques and costs related to cross country transmission and pressure piping systems. Hand welding techniques are described. Also covered are API pipe specifications, analysis and properties. Includes chart on pounds of electrode consumed per joint for various size pipe using hand or automatic submerged arc welding.

132 Hardfacing Electrodes, Wires —Cross-referenced pictorial data on hardfacing materials classified according to use is presented by Air Reduction Co., Inc. in 44-pp Form ADC 955. Lists equipment parts that benefit from hardfacing, type of wear and alloy needed to protect it.

133 Save Money with Metallizing —Maintenance cost reduction through rebuilding of worn parts with the metallizing process is detailed in series of case histories presented by Metco Inc. in 6-pp Bulletin 15.

Electrical

134 Motor Application Guide—Sixteen-pp Bulletin 010, Century Electric Co., describes single-phase, three-phase and d-c motors, also gearmotors and selective speed drives. Selection charts match motor characteristics to specific applications. Polyphase and single-phase motor characteristics are discussed and rating and dimension tables included in the bulletin.

135 On Electrical Machinery—Important theoretical and practical features of common types of d-c and a-c motors, generators and control equipment are presented by Fairbanks, Morse & Co. in 48-pp Bulletin E-100 P. Titled an "Electrical Machinery Catechism," it covers the electrical terminology and phenomena. Profusely illustrated with electrical rotating machines and allied equipment.

136 Ventilated Transformers — Sound level graphs, dimensional drawings, and photos are included in Niagara Transformer Corp.'s 8-pp Bulletin 162 on ventilated dry-type electrical transformers.

137 Low Voltage Switchgear — Twenty-pp Bulletin 3200-1A by I-T-E Circuit Breaker Co. provides comprehensive information on low voltage power circuit breakers and switchboards, ranging in unit ratings from 225 to 4000 amp. Application data, ratings tables, specifications included.

138 Combination Safety Starters—Bulletin GEA-7321 describes General Electric Co.'s combination safety magnetic motor starters offering protection against unauthorized entry and personnel injuries. Outline dimensions and other data are included.

139 Metal-Clad Switchgear — Features and details on switchgear ranging from 2.4 to 13.8 kv and 75 to 1000 mva are presented by General Electric Co. in 42-pp Bulletin GEA-5664F. Discusses basic equipment arrangements and includes charts and diagrams.

140 Switchgear Enclosure—Eight-pp Bulletin GEA-7190 describes installation of metal-clad switchgear with protected aisle, and includes photos, dimensional drawings, ratings and weight tables of outdoor metal-clad switchgear with protected aisle, with common aisle and outdoor metal-clad switchgear breaker compartments. General Electric Co.

141 Industrial Limit Switches—Featured in 12-pp Bulletin 201 by R. B. Denison Mfg. Co. are heavy-duty and precision plug-in limit switches for industrial applications. Mounting diagrams, contact arrangement and specifications are included.

142 Power Fuses—Bulletin FC4 issued by Line Material Industries, McGraw-Edison Co., describes power fuses rated 200 amp continuous current and designed to handle full range of fault current from slight overloads through high interrupting capacities.

143 Dielectric Testing Equipment —High-voltage testing equipment for dielectric materials and all kinds of insulated apparatus is described in General Electric Co.'s twelve-pp Bulletin GEA-7178.

144 100-Amp Bus Duct—Eight-pp Application Data 30-666 Westinghouse Electric Corp. describes 100-amp bus duct and tells how the benefits of conventional bus duct—flexibility, re-use, frequent plug-in openings, etc.—can be obtained for installations where smaller blocks of power are used.

145 Silicon Rectifiers—Detail information on features, operational characteristics and construction of General Electric Co.'s silicon d-c power supplies is presented in 6-pp Bulletin GEA-7066. Covers three basic types—general purpose, essential service, and synchronous-motor field-excitation units.

146 Silicon Diffused Rectifiers — Mechanical and electrical specifications for 150 different silicon rectifiers, including lead-mounted types, stud-mounted types of standard and reverse polarity construction, and ceramic insulated study types as well as rectifier mounting hardware are given in this 6-pp Bulletin by Raytheon Co.

147 Line Post Insulators—Bulletin TIA-182 describes features and applications of General Electric Co.'s Locke

more Current Catalogs page 85

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of Air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

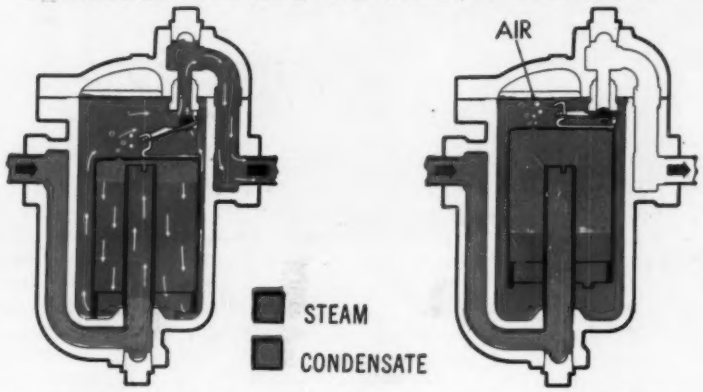
By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

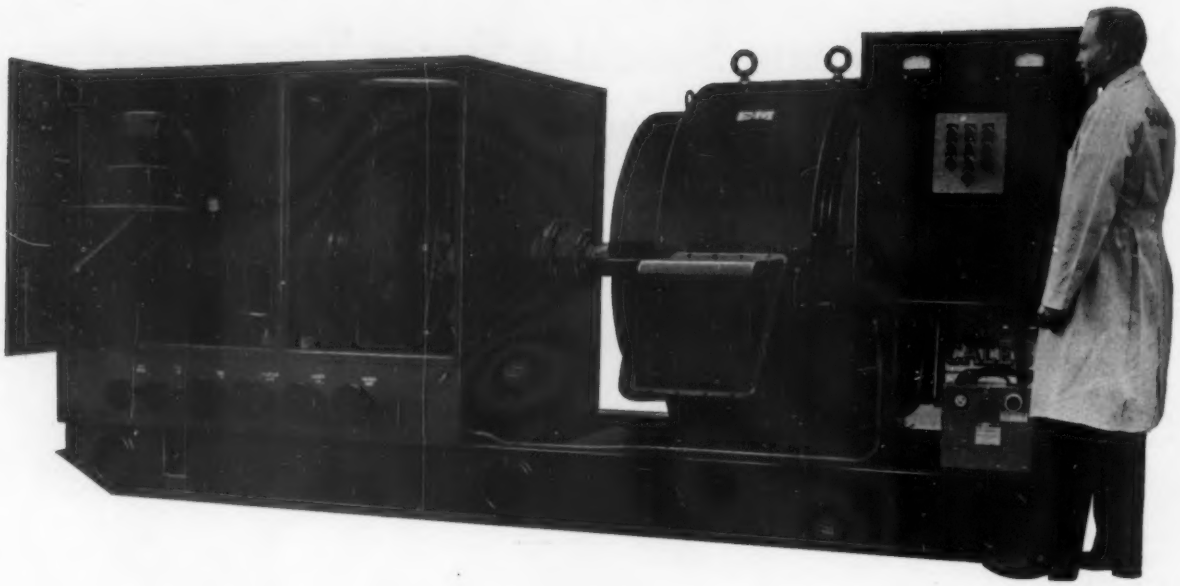
Armstrong Machine Works
8104 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

813-ST

"See our catalog in Sweet's Plant Engineering File"

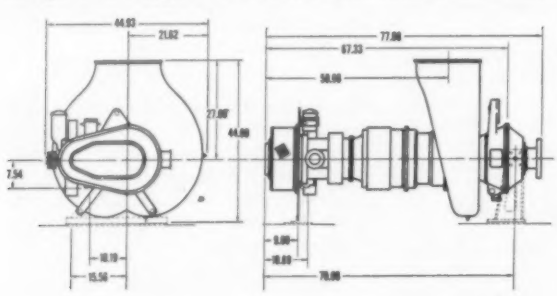
For more data circle 520 on Post Card



800 KW!

Solar industrial gas turbine generator sets ideal for peak loading or constant duty

Versatile, compact industrial generator sets powered by Solar's T-1000 gas turbine engine have a nominal rating of 800 kw. They are ideal for either peak loading or constant duty electrical power applications. Simple design and rugged construction reduces maintenance



to a minimum. Installation is extremely simple. The engine is about 1/10th as heavy as diesel units of similar horsepower and occupies only 51 cu ft. No elaborate foundation or flooring base is required because the gas turbine is practically vibration-free.

Equipped with one of the several control systems available, the engine can be operated remotely and entirely automatically. It starts instantly and operates at full load without warmup, even after long periods of standby service.

Fuel economy of the Solar T-1000 engine is unmatched in its field. The engine runs equally well on a variety of fuels including gasoline, diesel fuel and natural gas. The exhaust may be used in a waste heat boiler or as combustion air in process apparatus or conventional boilers.

Cost of this gas turbine is competitive with diesel engines in many industrial applications. For further information on Solar's turbine-powered generator sets, its complete line of gas turbine engines or industrial compressors, write to Dept. J-113, Solar Aircraft Company, San Diego 12, California.

SOLAR

A subsidiary of International Harvester Company

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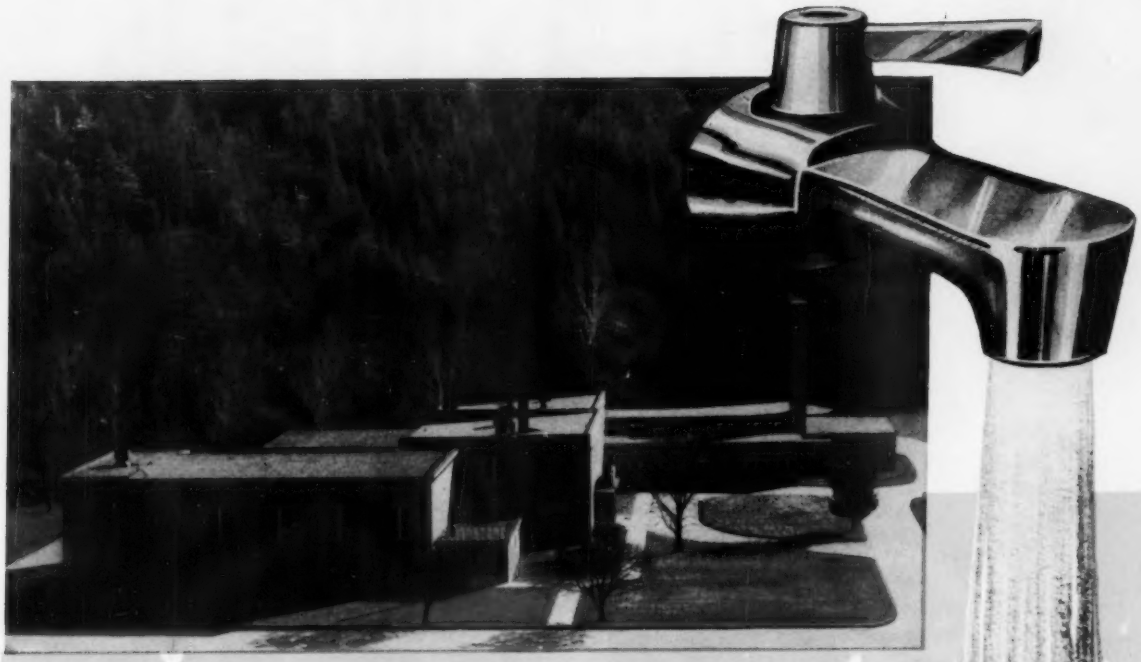

one of the toughest water problems in the country . . . solved by—

MOGUL-IZING...

...at Flintstone School, Flintstone, Maryland

Before using MOGUL, calcium formations were *actually visible* at the open end of faucets. A leaky faucet caused build-up of a calcium formation that was described as "hard as marble".

Boilers were also troubled with the same hard scale. The water analysis chart shows the actual condition of the untreated water. By MOGUL-IZING the raw water supply, calcium formations have entirely disappeared and flow has increased measurably.

MOGUL is proud of the "job well done" at Flintstone School. MOGUL is proud to be serving thousands of the nation's schools, colleges and universities as well as hospitals, hotels, public buildings and industrial plants of all types.

MOGUL-IZING is the answer to more efficient operation of your equipment through "personalized" treatment of your specific water problem.

Sample	WATER ANALYSIS REPORT (expressed in ppm) No. 1
Total Hardness	2200
Calcium	1580
Magnesium	620
Silica	15
Phosphate	.5
Iron	0
Phenol. Alkalinity	0
Total Alkalinity	160
Chloride	7
Total Dis'd. Solids	1350
pH	7.4

The North American

MOGUL

Products Company

Standard Building • Cleveland 13, Ohio

SPECIALISTS IN INDUSTRIAL WATER TREATMENT FOR OVER 40 YEARS

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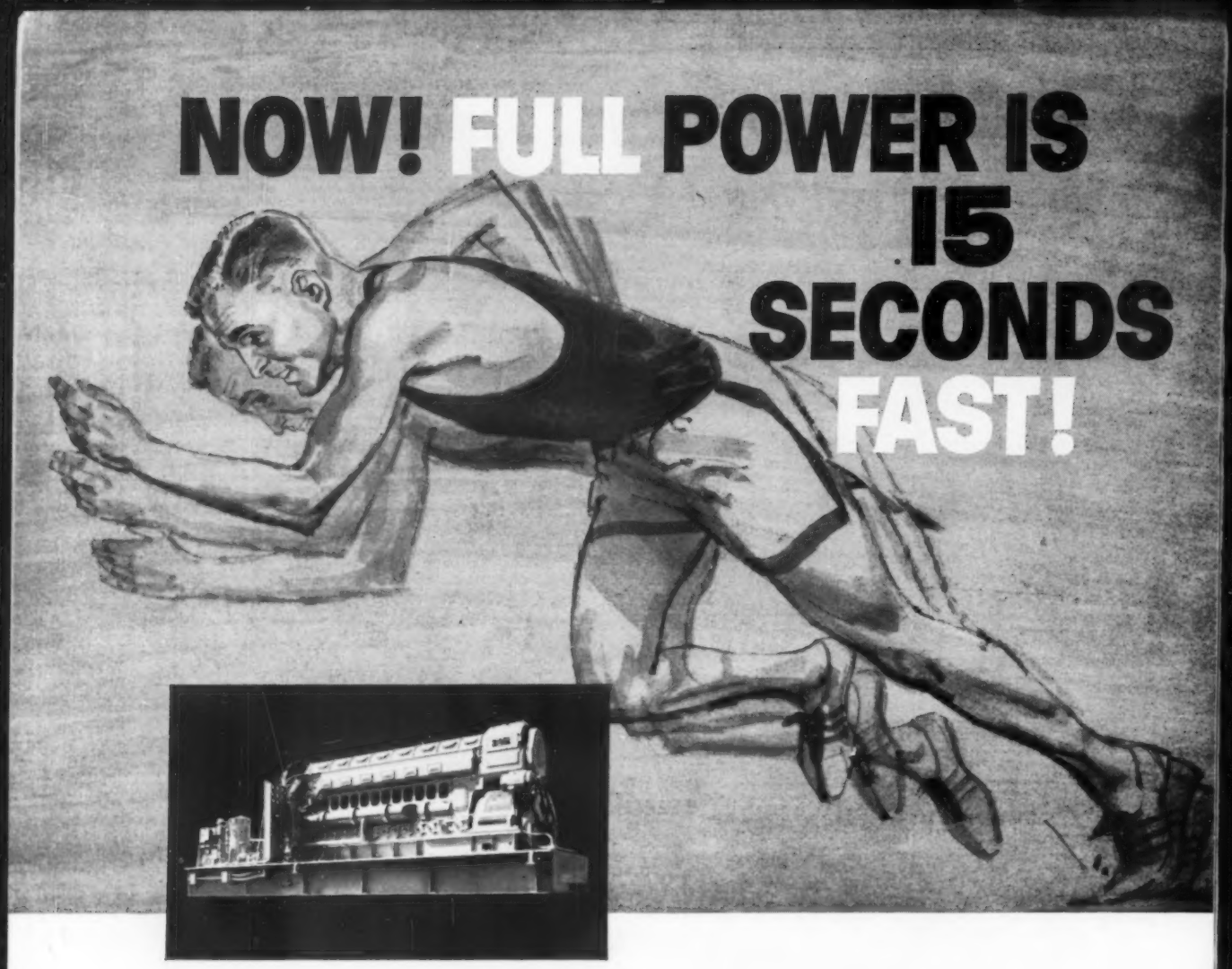

Solve peak-load and standby problems! F-M's exclusive O-P Diesel Generating Units provide *full* power in 15 short seconds . . . *from a cold start!* They need no spinning reserve. Use no power till you use them! The reason? Our exclusive O-P (Opposed-Piston) design. Two pistons in one cylinder function from a *single* combustion. This minimizes *vibration* . . . produces fine *balance, smooth* power to peak the generator—in just 15 seconds! F-M Opposed-Piston Diesel Generating Units are available with automatic or manual controls. Produce up to 2500 kw per unit. They may be linked in multiple units for peaking, standby duty . . . or dead load pickup! You can't buy better—or more economically.

For full details or custom specifications, write today to: **Mr. S. K. Howard; Diesel Division; Fairbanks, Morse & Co.; Beloit, Wisconsin.**

FAIRBANKS MORSE
A MAJOR INDUSTRIAL COMPONENT OF
FAIRBANKS WHITNEY

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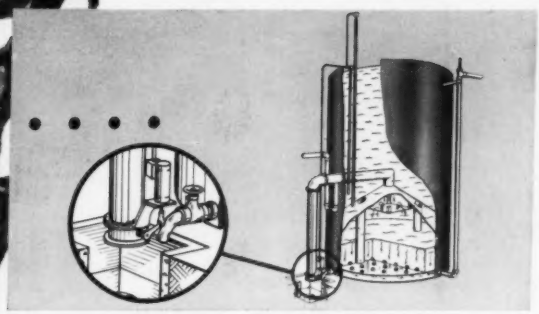
a butterfly at heart . . . .



At the heart of every Graver MONOVALVE Filter is one butterfly valve—the one valve so important that it gives the filter its name. With a flip of its "wings" it performs the vital function of directing water to the filter beds, or sending it past them.

The MONOVALVE, independent as a butterfly, requires no operator attention since its performance is completely automatic, eliminating much of the chance of human error.

But the MONOVALVE Filter is no butterfly when it comes to work. It is a fully automatic gravity filter, with special plastic sand-retaining "Partilok" strainers. Backwash is initiated automatically by pressure drop across the filter bed, so the MONOVALVE can never be overloaded. Because it stores its own backwash water, the MONOVALVE assures uniform and complete backwashing every time. And, no water is wasted in developing a vacuum here—the only water that goes to the sewer is that which is actually used to backwash the bed.

Accelerated life tests conducted with the MONOVALVE Filter have shown no effects of wear or fatigue after the equivalent of twenty years of service.

The versatile MONOVALVE Filter can be obtained in single or multi-compartment units. Write for Bulletin WC-130, to discover its applications for your filtration problems.

Industrial Department I-333

GRAVER WATER CONDITIONING CO.

216 West 14th Street, New York 11, New York

ONE OF THE UNION TANK CAR COMPANIES

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AUTOMATIC COLORIMETRIC ANALYSIS

in the parts per billion range

Now you can perform delicate colorimetric analyses for silica and other parts per billion trace contaminants right on the plant floor . . . without supervision. Quantichem® Analyzers continuously, automatically perform every step of a wet laboratory analysis with unprecedented accuracy and dependability. The field-proved Quantichem analyzer is so stable and foolproof that it actually provides *greater accuracy and repeatability than tedious manual techniques.*

The first step in each Quantichem analysis is standardization, in which *sample* and *zero* cells are flushed with sample while the instrument zeroes itself. Although no Quantichem analyzer has yet exhibited so much as 1% drift in 24 hours, standardization is a valuable safety feature. It ensures results *independent of photoelectric tube characteristics, line voltage variation, sample turbidity, or dirt on the cell windows.* If a dirty cell window or failing light source prevents zeroing, an automatic signal is actuated.

After standardization, the pneumatic programming drum which controls the instrument actuates the unique Minus Delta P® diaphragm metering pumps. Precise amounts of as many as four reagents (within $\pm 0.25\%$) are delivered to the cells in the desired sequence. The analysis reaction is permitted to go to completion, *eliminating any chance of temperature or timing errors.* The dual beam optical system which illuminates both cells ensures uniform light intensity and *eliminates possible errors due to light source inequality.*

Any difference in light intensity transmitted by the two cells unbalances the measuring bridge circuit, actuating the Quantichem recorder and associated instrumentation. Then a new analysis cycle begins with flushing of the cells and standardization.

Quantichem analyzers are now available for dissolved silica, dissolved oxygen, hydrazine, total hardness, residual chlorine, dissolved iron, and other trace determinations. Most analyses are accurate to within $\pm 3\%$ of full scale, and sensitive to $\pm 1\%$ of full scale. Designed and built to take tough industrial usage, Quantichem analyzers provide long service life with minimum maintenance. All wetted parts are constructed of corrosion-proof materials.

Complete information on them is provided in Bulletin 1156-1, available on request. Write to Milton Roy Company, 1300 E. Mermaid Lane, Philadelphia 18, Pa.

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CHEMICAL INSTRUMENTATION SYSTEMS

Controlled Volume Pumps
Colorimetric Analyzers
Hydrogen Purifiers
Laboratory Instruments

1936-1961
25 YEARS

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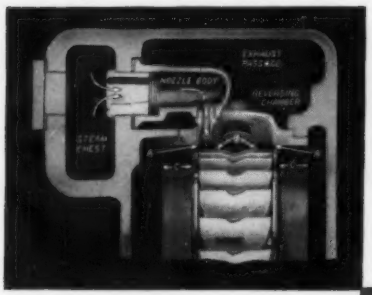
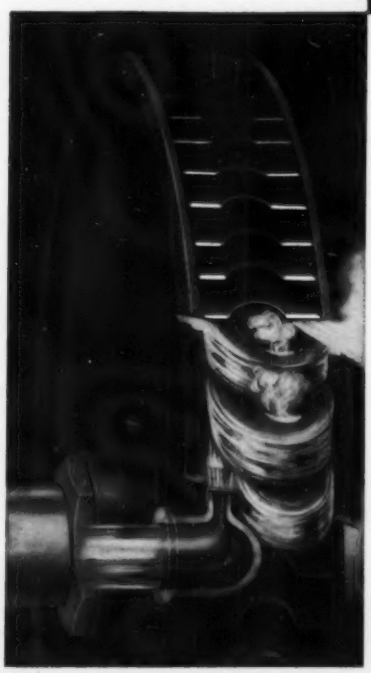


TWO REASONS WHY

this turbine seldom sees down time

1 ***Generous wheel clearances:*** AA —rim clearance, B—blade clearance, CC —side clearance. Blades can't foul as they are protected by rims. Rubbing at AA will do no damage. Side clearance is so large (about one inch) that end-play from excessive external thrust cannot damage wheel.

2 ***Blade wear is of little consequence.*** In a Terry solid-wheel turbine, the steam enters the buckets at right angles to the shaft. As its power-producing action takes place on the curved surfaces at the backs of the buckets, wear does not materially affect horsepower or efficiency.



To prevent costly shutdowns for repairs, Terry builds bonus reliability into each solid-wheel turbine. Two of the ways in which this is accomplished are shown in the diagrams at the left.

Further details of these simple, fool-proof turbines are illustrated and described in bulletin S-116. If you do not already have a copy of this publication, send for one today. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1217

TERRY

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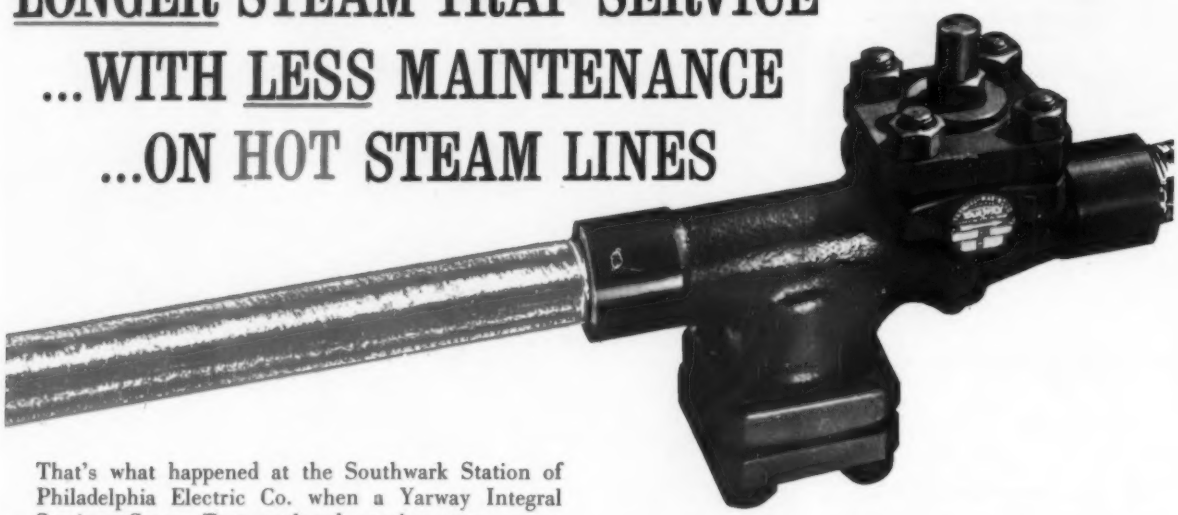
YARWAY news briefs

from **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD
STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS

LONGER STEAM TRAP SERVICE ...WITH LESS MAINTENANCE ...ON HOT STEAM LINES



That's what happened at the Southwark Station of Philadelphia Electric Co. when a Yarway Integral Strainer Steam Trap replaced another trap on an attemperator coil installation.

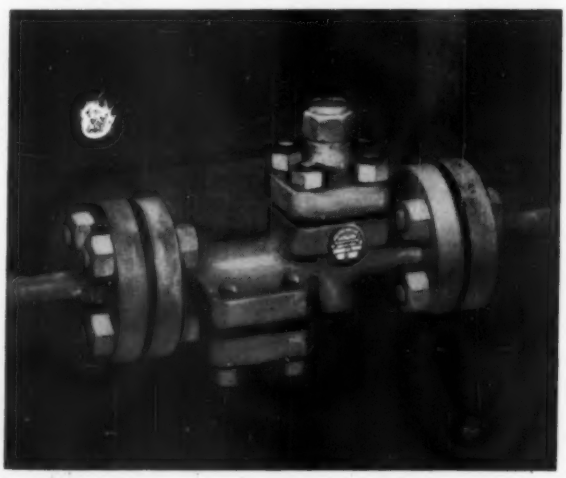
Operating pressure was 850 psi; temperature, 900° F. Other steam traps failed to operate longer than 4-6 months, and even that involved considerable maintenance. The first Yarway installed has operated *trouble-free* for over 10 months . . . is still going strong. Additional Yarway Integral Strainer Traps, installed on similar service, are performing just as well.

Utilities and other high pressure plants all over the country know and use Yarway Integral Strainer Traps for these reasons:

- Ample condensate capacity when system is being warmed-up—but also will handle small amounts of high temperature condensate without losing prime.
- Trap valve closes positively in presence of dry or superheated steam.
- Small size—rugged design.
- Built-in strainer with stainless steel woven wire screen and protective casing.
- Flanged or socket-welding ends available.

Consider these Yarway advantages for the "hot" lines in *your* plant. Write for full information on Yarway Integral Strainer Steam Traps.

Yarway Integral Strainer Impulse Steam Trap (flanged design) on attemperator coil at Southwark Station of Philadelphia Electric Co. Operating pressure 850 psi, temperature 900° F.



OTHER YARWAY IMPULSE STEAM TRAPS
FOR SPECIFIC OPERATING CONDITIONS

AVERAGE CONDENSATE LOADS	EXTRA HEAVY CONDENSATE LOADS	LIGHT TO MODERATE LOADS	
Series 60 and 120	Series 40	Series 30	Series 130

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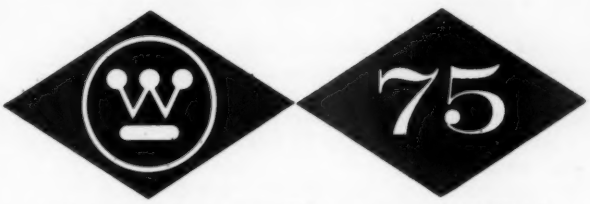
OUR ELECTRIC POWER APPARATUS . . . AND HOW IT GREW

This year Westinghouse Electric Corp. reaches its 75th anniversary — a life span which coincides with that of the power industry. To tell the story of one is to draw heavily on the other. So this quick review of electric power engineering progress stands as a birthday salute both to a great industry and to a company which has done much to make it great



Westinghouse Diamond Jubilee

TURBINES. In this country the steam turbine and the 20th century arrived together. The first turbine for central-station service began operation early in 1900 in the plant of the Hartford Electric Light Company—a 2000-kw, 1200-rpm condensing turbine. Today the modern high-speed machines currently going into service have over 150 times this capacity.

Rapid increase in ratings was made possible by the constant efforts of research scientists and engineers who have come up with new and better materials and processes, and who have contributed new basic knowledge of nature and various materials. Since 1900, the temperature of steam admitted to turbines has risen from 350 to 1200 F. In addition, the maximum rating of 3600-rpm generators rose from 4000 to over 500,000 kva.

In his quest to eke out the last kilowatt-hour per pound of fuel, the turbine designer has been continually pushing inlet steam temperatures upward. Casings of early steam turbines were made from cast iron, and later from cast carbon steel. As temperatures rose above 800 F, the turbine builder resorted to carbon-molybdenum alloy steels to prevent metal parts from undergoing gradual stretching under load. Still higher temperatures led to the addition of chromium to stabilize the steel against graphitizing weld-zone embrittlement and to enhance its creep-resisting ability. The next step employed austenitic steels that are stronger than ferritic materials at high temperatures.

Austenitic steel is used on the turbine built by Westinghouse for the Eddystone plant of the Philadelphia Electric Co. This turbine takes steam at 5000 psig, 1200 F; has a station heat rate approaching 8000 Btu per kwh; rated at 325-Mw load; occupies less than 10 square feet of station floor per 1000 kw; and weighs less than four pounds per kilowatt. Compare this performance with the low-pressure, low-temperature turbines of the early thirties. These turbines took steam at 650 psig, 825 F; had a station heat rate of 13,000+ Btu per kilowatt-hour; occupied more than 20 square feet of station floor space per 1000 kw, and weighed 16 pounds per kilowatt.

Today's achievement was realized only through: 1, continued research on basic phenomena in an attempt to understand better the behavior of metals under stress, and alloy development to overcome shortcomings of otherwise promising materials; 2, metallurgical process development, especially in the metal-joining field, to enable fabrication of these new materials; and 3, design development aimed at using new materials to maximum advantage.

GENERATORS. Generator development can be arranged in three periods. Between 1900 and about 1920, the larger ratings were built for 1200 rpm. Maximum ratings of

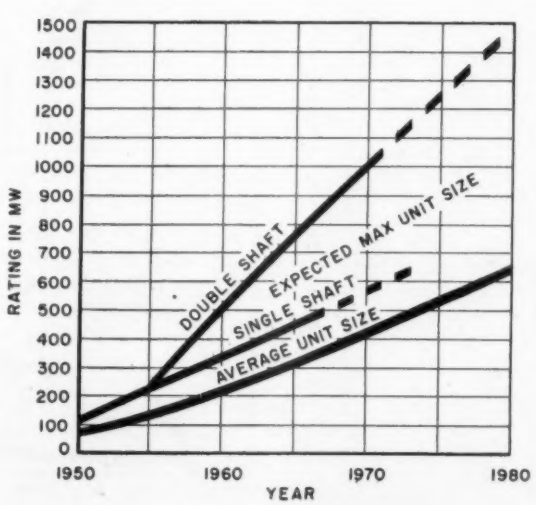


Fig. 1. Graph shows projected unit sizes

62,500 kva were reached. In the intermediate period, from 1920 to 1935, 1800 rpm was predominant speed, and machines up to 183,000 kva were built. Starting in 1935, 1800 rpm gave way to 3600 rpm, and hydrogen replaced air as the cooling medium.

But despite the improvement brought about by hydrogen, heat generated in copper conductors had to escape through layers of insulation. The answer came in a new ventilation technique called inner-cooling.

Here the conductors are made hollow and the hydrogen gas blown through them at high velocity. Thus, hydrogen gas, the cooling agent, is in intimate contact with the source of heat, resulting in more efficient heat removal than any previous method.

Inner-cooling made it possible to obtain almost twice the electrical output from a machine of given physical size. This permitted a reduction in rotor weight approaching 50 per cent with a marked decrease in rotor diameter.

The first inner-cooled generator has been in service over seven years. It has a nominal rating of 100,000 kva at 30-psig hydrogen pressure, and a maximum rating of 125,000 kva at 45 psig. Inner-cooled units having a total capability of more than 25 million kva have been built or are on order.

Inner-cooling has enabled designers to keep well ahead of the electric utility needs for larger, more efficient turbine-generators. The average size today is over 200,000 kva, and a unit capable of producing a staggering 422,400 kva has recently been placed in service. For tomorrow's systems, single-shaft generators with capabilities as high as 535,000 kva are on order and being built.

INSULATION. The scientific approach to insulation design and application began in 1891 when Westinghouse made the first high-potential dielectric tests. The mica on paper or tape, i.e., the folium or wrapper type of insulation which had been introduced in this country by Westinghouse, was simply wound round the coils.

In 1911, mica-folium slot insulation applied with heat was the next great improvement. It continued in use with shellac bond until 1926, when mica folium was modified by replacing the shellac with a plastic asphalt bond, and the asphalt-bonded mica tape was substituted for varnish-cambric tape as end-turn insulation.

In 1928, fiber-glass insulation was adopted as a surface binder for coils, replacing cotton and partially replacing asbestos finishing tapes. Likewise, glass twine was quickly adopted for lashing the end windings.

In 1950, Westinghouse announced a new concept of insulation fabrication wherein the various new components are combined into an integrated insulation system by new processing methods based on advances in chemical engineering. Continuous progress is being made in the development of these components.

EXCITERS. Before 1910, generator excitation was obtained from a separately driven motor-generator set or from a battery. Direct-driven main and pilot exciters were quite generally used on large turbine-generators, predominantly of 1800 rpm, and waterwheel generators between about 1925 and 1935. Today exciters are built with capacities in excess of 1500 kw, and higher ratings will be needed soon.

A new type of excitation system developed by Westinghouse eliminates the collector rings, collector brushes, commutator, and commutator brushes. The system consists of a permanent magnet pilot exciter, an a-c main exciter, and a rotating rectifier mounted on the same shaft as the field of the a-c turbine-generator. The

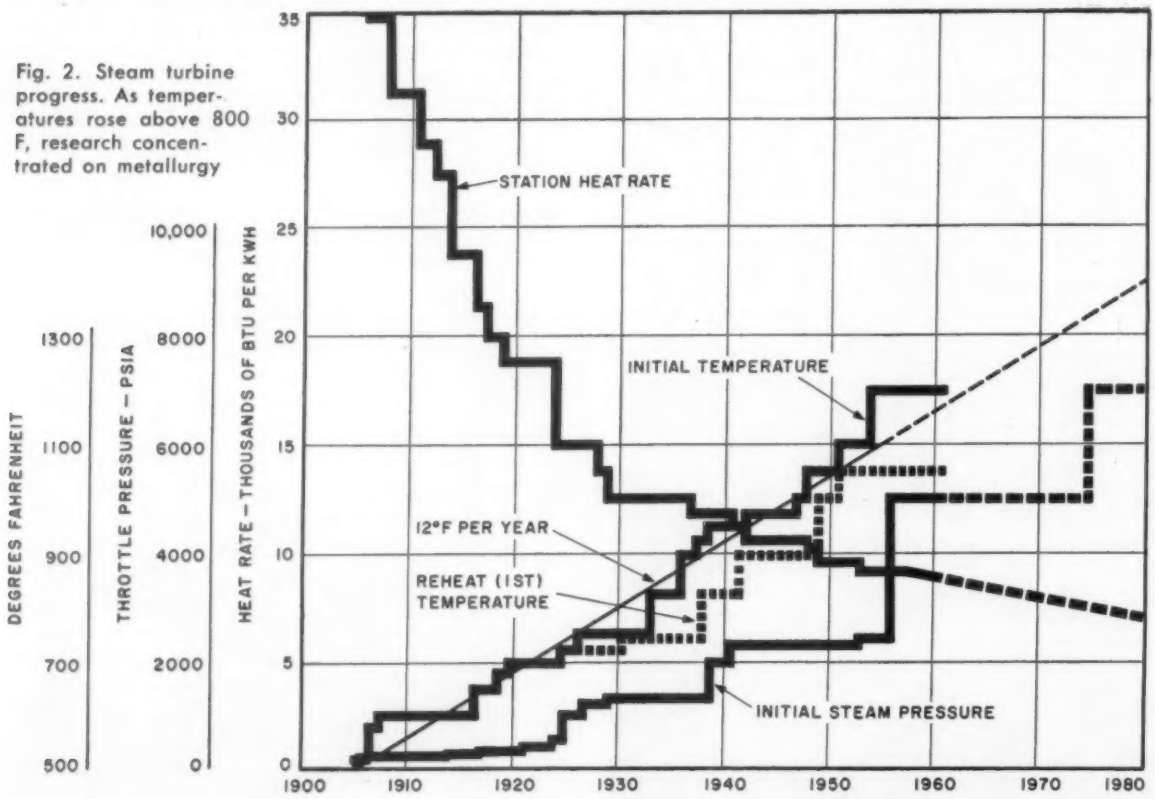


Fig. 2. Steam turbine progress. As temperatures rose above 800 F, research concentrated on metallurgy

total excitation power requirements, including the power supply of the regulator, are obtained from the generator shaft.

Brushless excitation systems of this type have previously been used in aircraft applications.

TRANSFORMERS. Much has happened to power transformers since 1886, when George Westinghouse introduced the first a-c transformer in the United States. For example, in 1897, Westinghouse built the world's largest oil-insulated transformer rated 850 kw and 11,000 volts for the Niagara Falls Power Co. In 1962, the company will ship completely assembled a 600,000-kva, 138,000-v generator stepup transformer which will be a new world's kva record.

The 1897 transformer weighed approximately 25 lb per kva while the modern 600,000-kva giant weighs only one lb per kva. The older unit had full-load losses amounting to 1½ per cent of its total capacity; the newer 600,000-kva unit has full-load losses of less than 4/10 of one per cent.

Commercial operating voltages have increased from 40,000 volts in 1897 to 345,000 volts today. An important development in this progress to higher voltages was the condenser bushing patented by Westinghouse in 1907, which has become standard today. Two more developments from the company in 1932—vacuum filling and "corona-free" design—contributed greatly to this trend to higher voltages. Impulse testing confirmed these methods and designs.

In 1932, Westinghouse also introduced forced-oil cooling and Hipersil steel. Forced-oil cooling is estimated to have saved the electric utility industry over $100 million by permitting 66⅔ per cent greater loading with the given amount of material in a transformer. Today 90 per cent of all units 50,000 kva and above are forced-oil cooled. Grain oriented core materials have reduced transformer core losses 50 per cent, which is said to represent a $50 million annual savings to the electric utilities in the United States. Better core steel has also resulted in smaller and lighter units. This in turn has helped make possible the shipment of larger three-phase transformers which cost less per kva.

In 1946, Westinghouse cooperated with the American Electric Power Co. in the 500-kv Tidd Project by building the first 500-kv transmission line transformer. This led the way to the present commercial 345-kv transmission. The company is again working with AEP on the 750-kv project at Apple Grove, W. Va. (A 125,000-kva, 750,000-v transformer was recently shipped and installed for this program.)

The industry axiom, "You can only build what you can ship," prompted Westinghouse in 1957 to build its first Schnabel railroad car. This car suspends the transformer between two trusses permitting 60 per cent larger kva ratings to be shipped. A new larger Schnabel car capable of handling transformers weighing 750,000 lb was just recently put into service.

Inner-cooled construction developed by the company in 1957 permitted another 20 to 25 per cent reduction in weight. This is a revolutionary arrangement of oil ducts, copper and cellulose insulating material which takes full advantage of the dielectric strength of the insulating material and the cooling efficiency of the oil.

IN 1958, a thermally stabilized cellulose insulation from Westinghouse permitted 12 per cent additional continuous capacity at 65 C rise with equal or greater life expectancy, as well as more overload ability. It also improved short circuit strength through tighter structures and insured better oil preservation.

Progress has been swift in recent years; however, continued research and development will open new doors to the future. The transformer of tomorrow will use new materials, new techniques of design and construction and will transform more kva per dollar.

SWITCHGEAR. By the end of 1900, Westinghouse was supplying oil circuit breakers for both indoor and outdoor use, from 44,000 to 110,000 volts, both hand and electrically operated, and incorporating the fundamental features which are still recognized as basically correct for high-voltage circuit breakers. By 1938, the largest breaker was 2½ million kva at 287 kv. Today breakers with 10 times that kva rating and for 345 kv are in service.

Compressed-air circuit breakers were introduced during the late 1930's because as loads and the number of circuits increased, substations were located in more congested areas and the potential damage from oil fires increased.

For 13.8-kv applications, ratings have increased in only a few years from 500,000 to 1,000,000 kva. This improvement in product capability is estimated to save electric utilities perhaps a half-million dollars in some large substations. Since less ground is required, as much as six to seven dollars per kva can be saved.

Today, circuits can be interrupted effectively in oil and air. These techniques will be used for some time to come. However, engineers in search for something that would replace oil and also an improved interrupting medium have come up with a non-toxic gas, sulfur hexafluoride, or chemically, SF_6. This gas has proved out so well that Westinghouse has built a number of breakers such as the first 230-kv, 15 million-kva breaker now in service at the Pennsylvania Power & Light Co. This circuit breaker is considered to be the most significant advance in arc interruption since the development of the de-ion grid in the early 30's.

Disconnecting switches and lightning arresters are equally important for the protection of high-voltage transmission circuits. Today, surge suppressing resistors built into disconnect switches ease the surge, reduce stress on insulation and apparatus on the line—a feature sometimes required for specific application on extra-high-voltage transmission lines.

The switchgear picture today is that all the protective equipment needed for tomorrow's super-voltages—circuit breakers, disconnecting switches and lightning arresters—can be supplied thanks to research and development.

SUMMING UP. The refinements resulting from keeping pace with new materials and methods have accounted for much of the progress in the past. These will continue in the future. Materials which appear extravagant today will be commonplace tomorrow. Of course, the myriad of materials available for investigation and test requires tremendous development effort and manpower on the part of the manufacturer. The technical feasibility of the use of these materials can be predicted, but the financing of such a program over a period of years requires the continued cooperation and support from the electric utility companies in this country. END

WATER ANALYSIS IS BIG BUSINESS

as this picture of a new laboratory shows

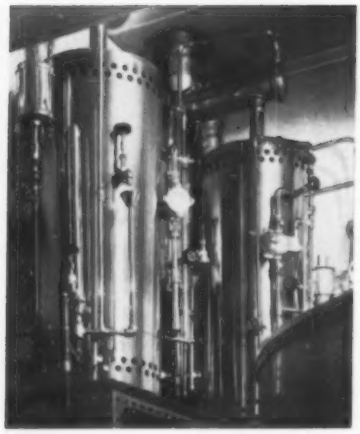
BETZ LABORATORIES, Philadelphia, recently completed installation of a newly equipped water analysis lab. This ultra-modern, 5000-sq ft workshop is currently handling water samples at the rate of over 55,000 a year, and has a staff of 30 chemists.

Samples are received from over 5000 clients throughout the U.S. and Canada. The average sample requires 10 different analyses, while some may need as many as 20. A special section of the completely air-conditioned laboratory is devoted to the study and development of new methods and techniques in water analysis.

Equipment of the new laboratory consists of seven island laboratory tables, four wall tables, three fume hoods, two steam hoods, three special instrument rooms, two offices and a conference room. Here are some unusual design features:

TABLES. The laboratory island tables were built to special Betz specifications. They are 26 ft long, have four sinks, are equipped with hot and cold water, distilled water, gas, and 110-220 electricity. Each table has eight knee-hole openings with adjustable hide-away laboratory stools. Each table is 40 inches high instead of the conventional 36 inches. Experience has shown that this height is less tiring for stand-up work.

DISTILLED WATER. There are 32 sinks in the laboratory, and each sink is equipped with a distilled water tap. Two 10-gallon-per-hour stills and a 750-gallon stainless steel reservoir tank are housed outside the laboratory. The distilled water is brought to each table by means of a stainless steel canned pump and piping that is made of stainless steel and plastic (PVC).



Still room has two 10-gph stills, a 750-gal stainless steel reservoir

One of two steam hoods for boiling non-corrosive chemicals reduces heat load and humidity

Instrumentation is used wherever practical. Here's a spectrophotometer being used for extremely accurate analysis

STEAM HOODS. While the laboratory has three conventional fume hoods for the handling of poisonous and corrosive gases, there are also two large steam hoods for the handling of non-toxic and unobjectionable vapor such as steam. These steam hoods are each 11 ft long and serve to remove a large heat load from the laboratory.

INSTRUMENT ROOMS are provided, although only two are in current use. One room is used for X-ray fluorescence for the analysis of water-formed deposits. The other is the flame photometer room for analysis of extremely low impurities such as sodium in parts per billion. These rooms have separate temperature controls and are used to provide protection for special instruments. END

X-ray fluorescent room for analysis of water-formed deposits

WILL NUCLEAR POWER REPLACE COAL, OIL, AND GAS?

No, says ATOMICS Editor Andrew W. Kramer

Following is a talk given by Mr. Kramer on June 1 at the Washington, D.C., Section of the American Society of Mechanical Engineers' Symposium on Fuel Trends and Economic Patterns.

IN A WORLD where there are still vast quantities of fossil fuels, it is not unreasonable to ask why we are so intent on developing atomic, or more correctly, nuclear power. Certainly, everyone in a position to know, knows that nuclear power costs more than power from fossil fuels both from the standpoint of capital cost and fuel costs. Also, our proficiency in building conventional power plants is well established; we have learned how to use extremely high steam pressures and temperatures conducive to high thermal efficiencies. Efficiencies in the neighborhood of 40 per cent are not uncommon, and the equipment is extremely reliable; we have boilers and turbines that can operate months and even years on end without shutdown. Despite the high steam pressures and temperatures used, these plants are not considered dangerous; we build them near or in populated areas.

On the other hand, everybody knows about the terrible dangers of radioactivity—just look at the SL-1 accident out in Idaho; three men killed. Of course, few people probably realize that these three men were the only ones ever killed in a nuclear power plant; that is, as a consequence of a nuclear excursion, but the story of the accident was given newspaper coverage from coast to coast. It brought home the dangers of nuclear plants with stark reality; three men killed. True, some 10 or 12 or 15 or more miners were killed in a coal mine accident in Southern Illinois not long ago, and that accident also received newspaper attention. Aside from general sympathy for the families and friends of the miners, however, there was no widespread feeling of alarm, no immediate gathering of the nation's top experts from all over the country to investigate the nature and cause of the accident and to continue such investigation for months on end as in the case of the SL-1 accident.

But, then, coal mining is not considered dangerous in the way nuclear power is; we are quite accustomed to coal-mine accidents. And the same is true of accidents in conventional power stations in recent years, and men have been killed in some of these; but rarely, except in the local press, are these accidents given much attention. We have come to accept certain types of industrial hazards.

SO, IN VIEW OF the radioactivity problem, the high cost of nuclear plant construction, the high cost of nuclear fuels, and the complexity of some types of nuclear power plants, it is reasonable to ask, why build them at all? Why not stick to good old coal and oil and gas, and leave nuclear energy to the military?

The answer, of course, as everybody knows, is that we just cannot help building nuclear power plants. Like Mount Everest, nuclear energy is there, and it must be explored. We are involved here with a new source of energy — a source of energy so concentrated and so vast in its ultimate potential that man would be like the proverbial ostrich with its head in the sand if he attempted to ignore it, and not try to use it for his benefit.

Although the conventional fuel resources of the world are adequate to fulfill the world's power requirements for many decades to come, in view of the constantly increasing demand for energy, there is no reason to assume that our fuel resources are as inexhaustible as they were once considered to be. Whether the pinch will come in the next 50 or 150 years is not of significant importance in the long run; the fact remains that the fossil fuel reserves are finite—limited in amount—and that some day they will run out and we will have to develop other energy resources. Nuclear energy is such a resource.

Various estimates and comparisons have been made of the world's fossil and fissionable fuel resources. In many instances the values arrived at depend upon who made the estimates, and there is wide variation in the figures, because various factors and personal prejudices have to be taken into account. In appraising fossil fuel reserves we have to distinguish between total and economically recoverable reserves. The latter involves all sorts of guesswork concerning future prices, population growth, estimated power use, technical progress, and many other things about which we can never be very sure. With respect to estimates of the uranium and thorium reserves, we are concerned with such things as degree of burnup in reactors, the possibility of breeding, questions of fuel enrichment, and, of course, reactor development itself. Uranium deposits are widespread throughout the world, but mostly the concentrations are very low.

THERE IS AVAILABLE, however, a great deal of easily recoverable uranium. Most comparisons of the energy available in the uranium reserves and in the coal reserves at present, and with a 1.4 per cent regeneration factor for the uranium, show the energy in the uranium to be some 20 times that in the coal reserves.

At the present time, there is little need to evaluate the merits of fossil versus fissionable fuels in terms of the ultimate reserves. For the present there is no reason to believe that our ever-growing use of power cannot be supplied by the conventional fuel reserves for many decades to come, at least as far as the United States is concerned. In the long term

—beyond the year 2000—vast population increase and worldwide industrialization presage vast energy demands which must inevitably tax the finite limits of conventional energy sources. Even the energy in the uranium reserves, great as they are, will ultimately be depleted. Long before that, however, we probably will have developed thermonuclear power plants, and then our power problems will be solved for all time. The energy in the deuterium in one gallon of seawater is roughly equivalent to that in 300 gallons of gasoline.

Although statistics concerning ultimate available fossil fuel and fissionable fuel resources and ultimate energy demands are uncertain, the general conclusion of recent studies is that fossil fuels can meet the energy requirements in both the United States and the remainder of the world for the rest of this century without difficulty and with only moderate increases in real costs. In fact, requirements twice as large as those predicted could be easily met provided that both the world and the United States adjusted consumption patterns to large increases in the use of coal.

BEYOND THE YEAR 2000 the adequacy of fossil fuel resources is less certain. Although over 90 per cent of the world's fossil fuel reserves (according to a recent AEC estimate) will still be available after the year 2000, continued compounding of fossil fuel requirements at the same rate as that predicted for the remainder of this century (slightly over 4 per cent per year) would exhaust the fossil fuel reserves by the middle of the next century. That time, the year 2050, is within the life-span of children now being born. It is therefore imperative that new sources of power be capable of supplying the increase in energy requirements after the turn of the century.

Of course, the assumption of a fixed growth rate until all the fossil fuels are exhausted is unrealistic. Long before that time the growth rate will decrease, perhaps even become negative, and it is most likely that some fossil fuels will be produced for centuries although probably for chemical raw materials rather than fuel.

So much for statistics and estimates of future energy consumption and energy resources. At the moment they have little bearing upon nuclear energy development. We are developing nuclear energy for other reasons than the possible future exhaustion of our fossil fuel reserves.

In thinking about nuclear power, we must remember that the nuclear power industry is less than eight years old. Calder Hall in Britain, the first large nuclear station in the world, went into operation only in October 1956, and our own 60,000-kw Shippingport Station reached completion late in 1957. Shippingport produced power at an initial cost of over 42 mills per kwh. This plant, of course, was built primarily to get information—in no sense was it an economic test. Dresden Station of the Commonwealth Edison Company, on the other hand, will produce power somewhere in the neighborhood of 11 mills per kwh, and Yankee, which went on the line recently, will produce power at about the same cost. This step in bettering economics is a dramatic one — it shows what has been done in a matter of three or four years. From here on, however, further reductions in power costs are going to be more difficult.

NUCLEAR PLANT capital costs and nuclear fuel costs are still too high. One reason for the high capital cost is the extreme caution used to insure safety. Designers have had to lean over backwards to meet the rigid requirements of the reactor safeguards committees. It has been necessary to use very expensive materials in the construction of reactors and reactor systems, and the control systems have had to be extremely complex and expensive. To reduce the hazards of third party liability in case of nuclear accidents it has been necessary to enclose reactors in expensive containment spheres which add to the cost of nuclear power. Moreover, by virtue of the low temperature at which we have had to operate reactors, the steam conditions of nuclear plants have not been favorable to the use of modern high-temperature, high-pressure turbine equipment, and this has added to over-all nuclear plant costs.

Despite these present drawbacks, there are many reasons for developing nuclear power plants. First, perhaps, is the extreme concentration of the energy in nuclear fuel. One gram of uranium-235 is capable of producing about 24,000 kwh of heat. When this capability is coupled with the intrinsically compact structure of nuclear reactors, all sorts of applications where fuel or system size and weight are restricted may be suggested.

Furthermore, in uranium we have a fuel which at the mine head is extremely inexpensive. If this is true, however, the question arises: Why are nuclear fuels so expensive? The fact is, we have failed to take advantage of this basic fact. Instead of concentrating on or retailing this cheapness of fuel at the mine head, what we have done is to develop a variety of reactor concepts which use some kind of fuel, but not necessarily a fuel designed explicitly to exploit this fundamental advantage of our nuclear energy resources. Forgetting all about other costs in the fuel cycle, fabrication costs alone are so far out of line that unless they come down there is no future in the business. They will, however, come down. Several nuclear reactor concepts; for example, the pebble-bed reactor, are designed with a particular type of fuel in mind.

At present, nuclear fuel costs run 3 to 4 mills per kwh. In Canada, Dr. Lewis, of Atomic Energy Canada Limited, expects to attain a fuel cost of about 1 mill per kwh in the operation of the CANDU reactor now under construction. Here, of course, they use natural uranium as fuel and heavy water as moderator.

ANOTHER ADVANTAGE of nuclear fuel is the fact that it does not need any other material for its burning. Most common chemical fuels assume the presence of oxygen in some form; in fact, the oxygen used in the burning of coal or oil weighs more than the fuel itself. This aspect of nuclear fuel makes it so valuable for submarine propulsion and for space applications.

The next item in favor of nuclear fuel involves the controllability of nuclear wastes, which is perhaps a bit of reverse English. Ordinarily, nuclear wastes, as I have already mentioned, are regarded as one of the most serious drawbacks to the use of nuclear power. Rather than considering fission products as a danger, it is the opinion of some reputable scientists that the degree to which we have been able to contain these products is a basic advantage. In the long run, it is quite possible that the increased carbon dioxide from fossil fuel energy sources constitutes more of a disturbing factor in our environment than the accumulation of nuclear wastes.

In the operation of a nuclear power plant, there is virtually no air

pollution problem. Nuclear power is perhaps the cleanest, the most easily controlled, and certainly the most silent power in the world. No one who has ever visited Shippingport Station and looked down into the pool of clear distilled water that covers the top of the reactor vessel to shield personnel from radiation can fail to have been impressed by the utter silence, the cleanliness, the complete absence of noise or vibration, and the freedom from dust and fumes.

Here, underneath this calm pool of water is a reactor generating over a quarter of a million kilowatts of heat energy, yet there is nothing to indicate to the senses that anything unusual is happening. And this power will continue to be generated day after day, month after month, even year after year without need to replenish the fuel. In the case of the *N.S. Savannah*, the first nuclear power merchant ship, the core of the reactor contains all the fuel that the ship will need for a period of 3½ years' operation.

BUT, ONE MAY ASK, what about the future waste disposal problem? Isn't that going to be increasingly serious as more and more nuclear stations are built? The most comprehensive answer to this question is contained in the Edison Electric Institute Report on Radioactive Waste Handling in the Nuclear Power Industry issued in March 1960. This report indicates that in the last 15 years more than 70 million gallons of wastes from processing spent plutonium production fuel, currently containing on the order of a billion curies of radioactivity, have been placed in large underground storage tanks at the AEC's Hanford and Savannah River plants. These tanks now have a total capacity of about 110 million gallons. At the present time, these wastes are being produced at a rate of about 5 million gallons a year.

Compared to these quantities, it is estimated that by 1980 an accumulated total of 1 to 10 million gallons of such wastes may have been generated in the U.S. from nuclear electric power fuels, and the production rate may be in the order of a million gallons per year, assuming that the domestic power industry has grown by then to about 35,000 Mw(e) of installed capacity. By the year 2000, the accumulated total might approach 100 million gallons assuming no improvements in technology. This is a manageable volume, and technical developments are likely to occur by that time which will decrease volumes. Thus, the radioactive waste problem, so far as nuclear power is concerned, is not expected to present any serious problems; and they are likely to be far less serious than the growing air pollution problem arising from the emission of stack gases from conventional power plants.

While nuclear power has a number of unique advantages, the important factor in its future development, of course, depends upon a reduction in both capital and fuel costs. At the present time, power from nuclear plants cannot compete, cost-wise, with power from fossil fuels, except in special cases, but the trend is decidedly downward, and in the industry it is generally agreed that nuclear power will become competitive with fossil fuel within this decade.

In a recent study, leaders of some 40 organizations were asked to consider the factors which bear on the future economic prospects of nuclear power. The first question concerned fuel costs. Since nuclear and fossil fuel costs are not far apart in certain areas, any material change in basic fuel costs could affect the competitive position. Therefore, the opinion on the prices of fuel 10 years from now is important.

The summary guess on the change in cost of fuel between the present and 10 years hence was, that whereas fossil fuels were expected to go up by over 12 per cent in 10 years, nuclear fuels costs would decrease by over 9 per cent in that time. Moreover, in that same period the efficiency of fossil-fuel-fired plants was expected to increase by only 2.9 per cent while nuclear plant efficiencies would rise by some 4.5 per cent.

THESE FACTORS concerning fuel costs and plant efficiency are not the only things that will affect the trend toward economic nuclear power. These factors merely set the stage for the ingenuity of designers in simplifying designs, reducing costs, and improving efficiency.

Taking all these various factors into consideration, it is estimated that by 1970 some 10 per cent of the total power generating capacity in the United States will be nuclear and that by 1980, this proportion will increase to 25 per cent.

Now, while one-quarter of the market in 20 years may not seem optimistic, it must be remembered that if this estimate turns out to be reasonably correct, 25 per cent of the new generating capacity ordered in 1980 would be over 10 million kilowatts, if we assume an annual load growth of 6.7 per cent. These figures translated into the total nuclear generating capacity on the line in order to measure the need for nuclear fuel give the following:

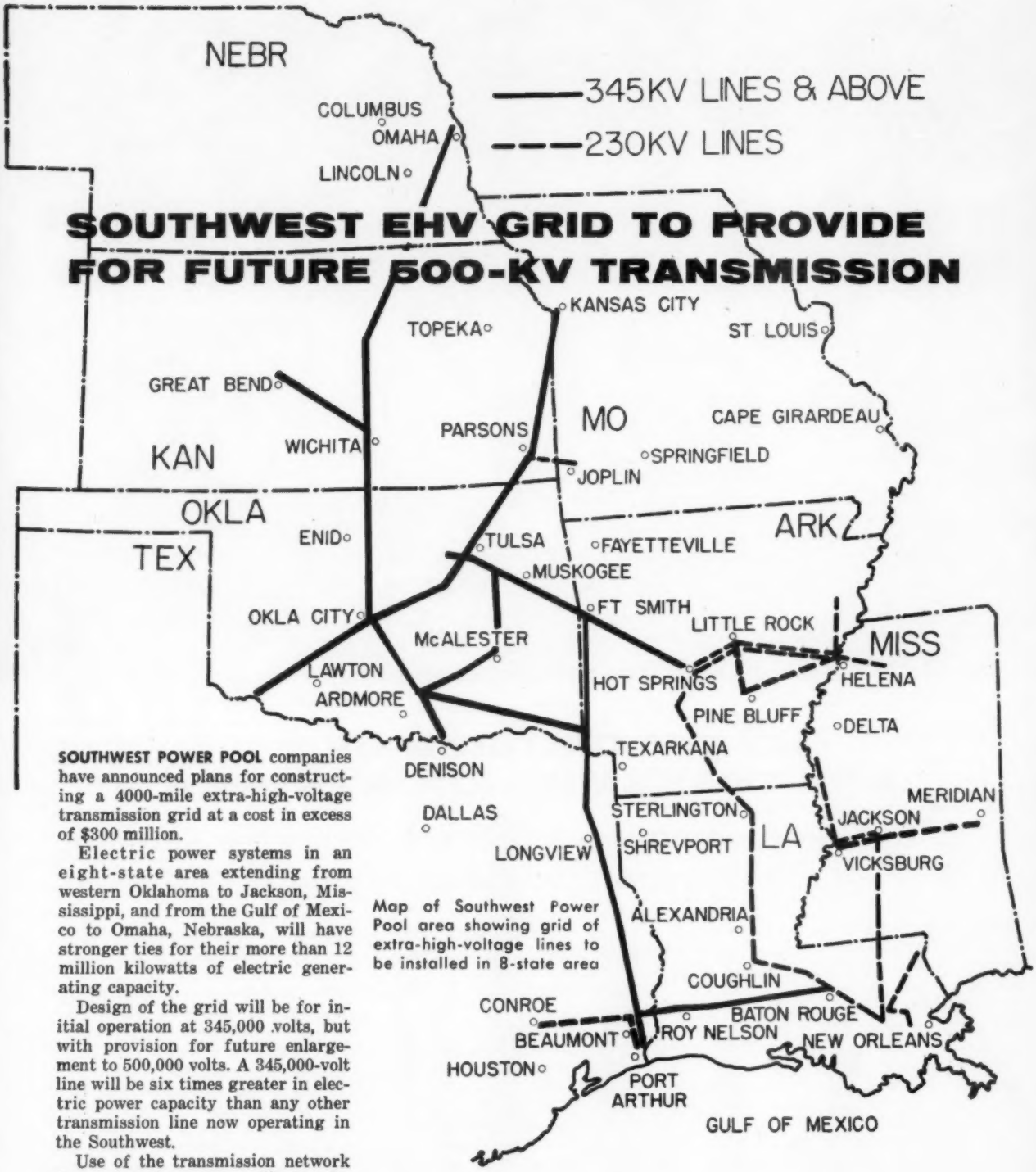
1965 ..... 1.4 million kw
1970 ..... 5.0 million kw
1980 .....45.0 million kw

These figures are for the United States. The prospects for nuclear power in Britain are even better. There it is expected that by 1967, 10 per cent of the total generating capacity will be nuclear, and that at that time, the best nuclear plants will be producing electric power at a cost slightly lower than the present average from fossil fuel plants of 6 mills per kilowatt-hour.

ALTHOUGH THE ESTIMATES of the world's fossil fuel reserves are considerably brighter on the basis of the most recent estimates than they were 10 years ago, especially with regard to western Europe, there are many economic reasons for developing other sources of energy. Twentieth century society is increasingly interdependent, but traditional political concepts of sovereignty and self-sufficiency still prevail. Nations are hesitant to rely on energy sources not under their direct control, yet the distribution by nature of conventional energy resources is so mismatched with centers of industrial populations that almost all industrialized nations now require energy imports.

For many nations, nuclear power has appeared to offer some opportunity to minimize imports, or at least to increase diversification of supply sources from which vital energy requirements can be drawn. This is the classic strategic argument which can motivate nations and regions to accept higher costs in return for greater independence from factors beyond their control. Economically attractive nuclear power arising within each country could ultimately provide new and severe competition for high-cost domestic fuels which in the past have been able to rely on protective tariffs and other political devices for competitiveness with low-cost fuels from other parts of the world. The advent of cheap nuclear power might be the means for continuing and extending the historic Western industrial leadership, based on low-cost energy. END

SOUTHWEST EHV GRID TO PROVIDE FOR FUTURE 500-KV TRANSMISSION



Map of Southwest Power Pool area showing grid of extra-high-voltage lines to be installed in 8-state area

SOUTHWEST POWER POOL companies have announced plans for constructing a 4000-mile extra-high-voltage transmission grid at a cost in excess of $300 million.

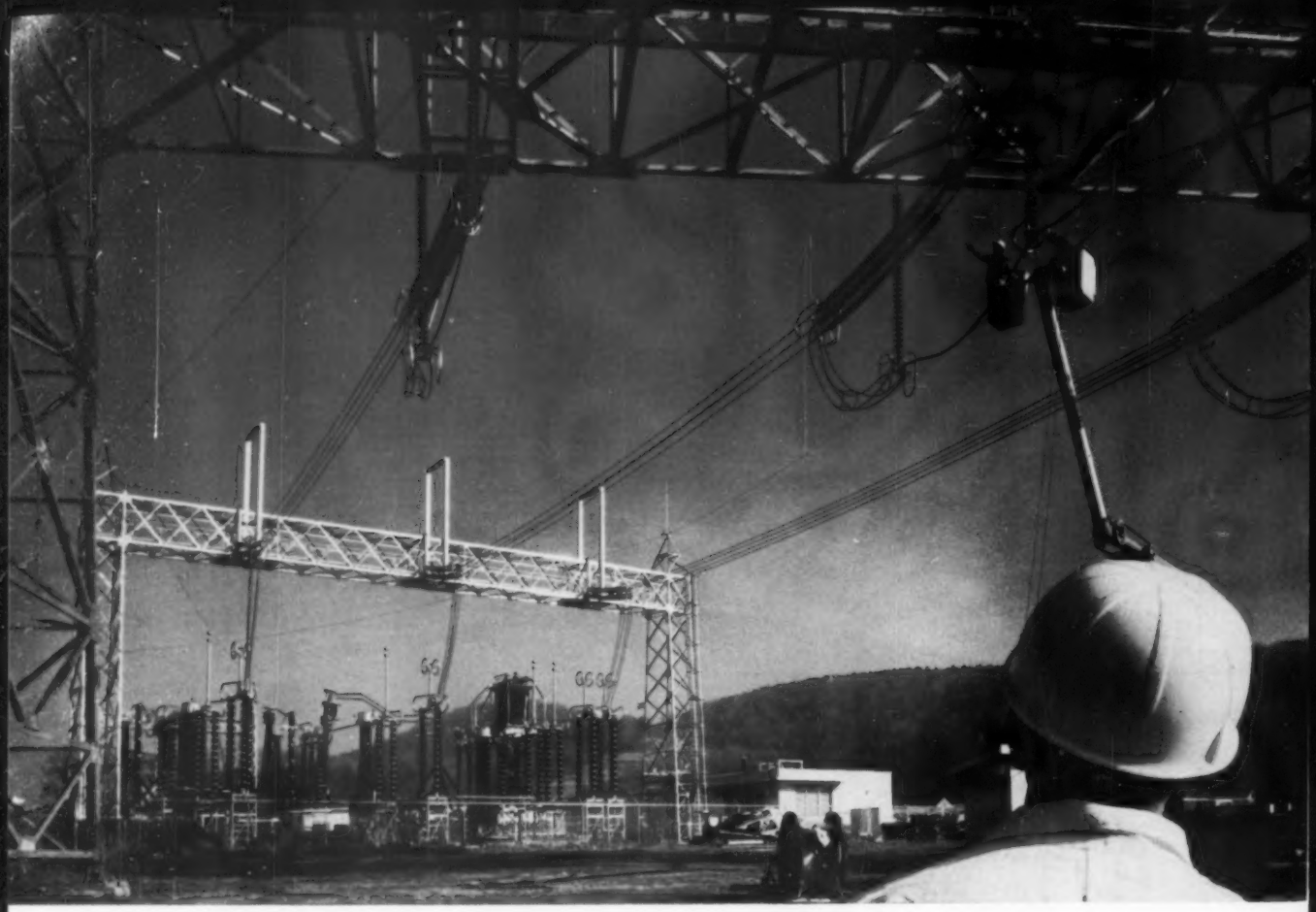
Electric power systems in an eight-state area extending from western Oklahoma to Jackson, Mississippi, and from the Gulf of Mexico to Omaha, Nebraska, will have stronger ties for their more than 12 million kilowatts of electric generating capacity.

Design of the grid will be for initial operation at 345,000 volts, but with provision for future enlargement to 500,000 volts. A 345,000-volt line will be six times greater in electric power capacity than any other transmission line now operating in the Southwest.

Use of the transmission network for exchanging power will give the participating companies a greater measure of flexibility in installing new generating units. It will also result in greater dependability of electric service in the areas that are served by the individual utilities.

Organization of the Southwest Power Pool dates back to World War II, when it served to meet the emergency needs of defense plants. It has continued since the war for exchange of electric power between 12 member electric companies and also for 22 additional associated electric systems.

This EHV grid is another step in the continued search of the investor-owned utilities for greater efficiency and economy, in order to combat rising costs of providing dependable electric service for an increasing number of customers. END



DESIGN CRITERIA OF EHV TRANSMISSION SYSTEMS

Complementing a first article on the subject, Dr. Pier Abetti here discusses elements of design

OPTIMUM SOLUTION of a given transmission problem may be defined as the solution with the lowest cost which will meet all the specifications and applicable standards, and insure the required reliability. In order to obtain the optimum solution, it is necessary to determine (1) the transmission voltage, (2) conductor configuration and cross section, and (3) insulation distances.

Choice of the voltage depends upon the distance, the power transmitted, the load factor, the economic evaluation factors for I^2R losses, corona losses and reactive power, the annual carrying charges on investment, and, last but not least, the estimated prices of the line and apparatus. Figure 1 shows the result of a recent study of bulk power transmission, 1500 Mw for 200 miles, at 60 per cent load factor.

It is interesting to note: (1) The decrease in the number of circuits required, from 20 at 138 kv, to 2 at 460 kv. The corresponding decrease in the required width of right-of-way is about five to one; (2) the fact that it is cheaper to transmit *coal by wire*, at 345 or 460 kv, than coal by rail; and (3) the significant differences between the terminal equipment costs (estimated in 1946) and the costs representative of average 1959 levels.

In 1946, voltages higher than 287 kv appeared to be uneconomical because of the high apparatus costs, whereas today 460-500 kv appears to be the most economical voltage. These advances are due partly to the use of lower basic insulation levels, improved protective devices and practices, greater knowledge about the behavior of insulation, and to larger unit sizes in transformers, with corresponding lower costs per kva.

Looking ahead, present development activity in terminal equipment and circuit design should lead to still further improvement in the economics of transmitting power at extra-high voltages.

Many important factors determine the electrical design and performance of extra-high-voltage lines. These can be classified according to three major areas: (1) Economics of conductor configuration and cross

section; (2) corona and radio noise; and (3) insulation with regard to lightning, switching surges, and 60-cycle voltages.

As discussed previously, the capacity of a transmission line is proportional to its surge impedance loading (S.I.L.) $= \frac{V^2}{Z}$, where V is the Voltage and Z the surge impedance of the line. Consequently the current $(I = \frac{V}{Z})$ increases proportionally to the voltage, if single conductors per phase are used, which have a surge impedance value of approximately 400. The cross section of the conductor is proportional to the current, and therefore to the voltage. If R is the conductor radius, then:

$$R \propto \sqrt{I} \propto \sqrt{V}$$

The maximum gradient, G, on the conductor is inversely proportional to the radius, so that:

$$G \propto \frac{V}{R} \propto \frac{V}{\sqrt{V}} \propto \sqrt{V}$$

Thus, as the transmission voltage increases, so does the gradient, although with a slower rate. As the maximum possible value for the gradient (in air) is approached, new phenomena appear which affect profoundly the design of EHV lines, stations, and apparatus. These are essentially *corona loss* and *radio noise*, which are relatively unimportant (as design criteria) for lines up to 220 kv.

CONSIDERING CORONA LOSS, it increases nonlinearly as a function of the ratio between the gradient on the conductor surface and the disruptive gradient, determined by Peek's classical formula. This ratio increases for constant diameter (with the applied voltage) and for constant surface gradient, with the conductor diameter. For these reasons, as the voltage increases above 220 kv it becomes necessary to use expanded conductors, or two, three, or four conductors in a bundle. Bundle conductors are effective two ways: because the average surface gradient is lower than on equivalent single conductors, and because the disruptive gradient is higher. On the other hand, bundle conductors require a more expansive tower design and present special mechanical problems.

Many semi-empirical formulas exist for the determination of fair-weather corona loss. A computer program has been developed, using Peterson's formula, modified for bundle conductors. This program calculates the gradient along the surface of the conductor, which presents a sinusoidal pattern, determines the loss as a function of the gradient, and finally integrates this quantity over the conductor surface, to obtain the total loss. The loss depends also upon the *surface factor* of the conductor.

This surface factor would be *unity* for a perfectly smooth tube. For an actual conductor, this factor is less than unity, and is the product of the stranding factor (0.92-0.95), and of an abrasion factor (0.7-0.95) which takes into consideration the handling of the conductor in the mill and in the field. If careful handling and tension-stringing is used, the value 0.90-0.95 is possible. Otherwise values of 0.7-0.8 must be used. For EHV transmission, corona loss may be more than doubled if the conductor is not handled with care; and, for a 100-mile, 460-kv line, this difference may be worth *approximately $100,000* per year. Careful handling of the conductor is equally important in minimizing radio noise.

MUCH LESS IS KNOWN about the calculation of corona loss during bad weather (fog, rain, snow, hoarfrost, and sleet), or even dust storms which occur in the desert. On experimental lines, ratios as high as 100 to 1 have been measured between the highest corona loss and the fair-weather loss. These results are difficult to extrapolate to actual lines for two reasons: test lines are short, from a few hundred feet to 1.4 miles (Tidd and Leadville); also, test lines do not carry power, and therefore the temperature of the conductor is the same as the ambient temperature.

On Project EHV lines, to be described later, these drawbacks will be partially eliminated because the line is 4.3-miles long, and there are three complete weather stations, one at each end, and one in the middle of the line. Furthermore, one phase will be heated by circulating current, up to twice the surge impedance loading.

On certain power lines with single conductors, it has been found that during extreme weather conditions, corona loss could absorb up to *half* the transmitted power. Therefore corona loss can be a real problem. It

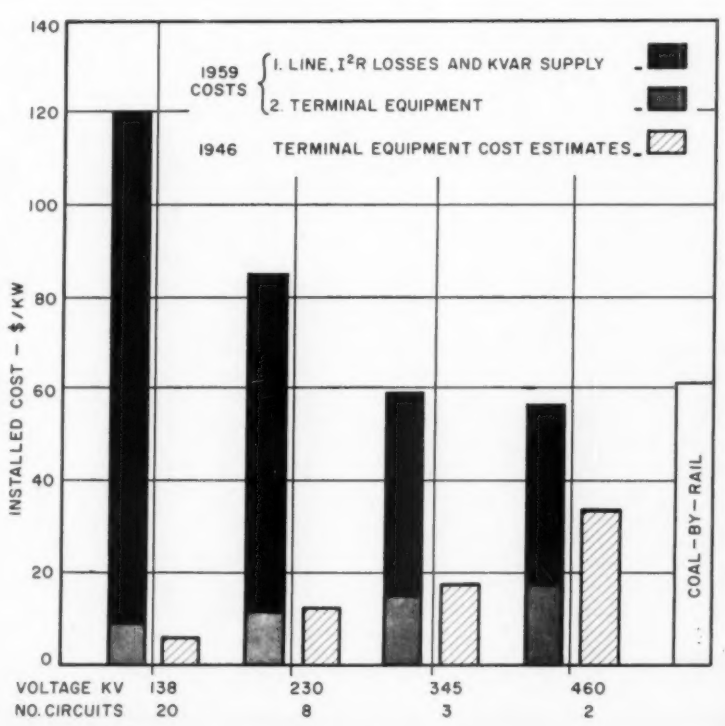


Fig. 1. Cost of transmitting 1500 Mw for 200 miles, at 60 per cent load factor, from generator voltage to a 138-kv receiving system

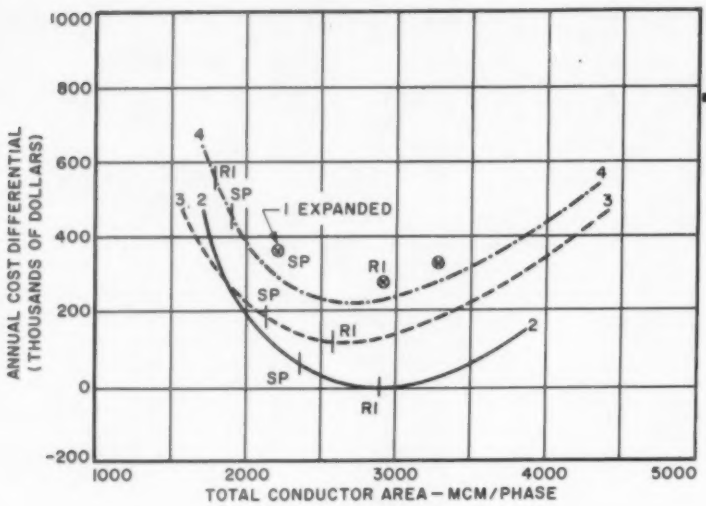


Fig. 2. Annual cost differential vs. total conductor cross section per phase, for transmission of 750 Mw over 250 miles at 80 per cent load factor

is generally believed, however, that if bundle conductors are used, corona loss can be controlled and fair-weather losses kept down to less than five per cent of the I^2R losses at surge impedance load.

Even at these low values, the economic significance of corona loss is not negligible, for two reasons. First, load losses are proportional to the square of the current, and the loss factor is about 50 per cent. (Corona losses are always present when the line is energized, so that their loss factor is almost 100 per cent.) Second, as we have seen, foul-weather corona losses may be many times higher than fair-weather losses. It is quite possible that the peak of corona losses is coincident with the system peak load, either in winter (heavy rainstorms, snowstorms, or sleet), or in summer rainstorms.

Consequently, corona loss is evaluated economically by applying an *energy charge* to the total yearly losses, and a capacity charge to the peak loss. In a computer program, for lack of more precise information, yearly average loss is assumed to be four times the fair-weather loss, and the loss at peak load, twice the yearly average loss. These ratios probably should be higher for single conductors than for bundle conductors.

Assuming the above ratios, the following evaluation may be made: (1) For a transmission line from a *hydro* station (with no storage facilities), the energy charge is assumed to be zero, and the demand charge to be $300 \times 0.15 = \$45$/kw/year. Therefore the evaluation of the corona losses is $2 \times 45 = \$90$ per kw of average corona loss per year. (2) For a transmission line from a *steam* station, the energy charge is assumed to be $\$2.50 \times 10^{-3}$ per kwh, and the demand charge to be $\$150 \times 0.15 = \$22.50$/kw/year. Therefore the evaluation of the corona losses is $2 \times 22.5 + 8760 \times 2.5 \times 10^{-3} = \$66.90$ per kw of average corona loss per year.

ECONOMICS OF CONDUCTORS. Extra-high-voltage lines for 380-400 kv (420 kv maximum) have been built in Europe with two, three, and four conductors per phase. At present an interconnection between Italy and Switzerland is being built, partially with single expanded conductors. It does not appear that these differences in line design are justified by system considerations, since loads and distances are often of the same order of magnitude. Similar differences occur for planned 460-500-kv lines in the U.S.A. and Canada. There are also considerable differences in the total cross section per phase, as would be expected.

As is well known, the over-all costs of transmission (capital investment evaluated at an annual rate, say 15 per cent, plus losses and operating expenses) depend upon the conductor cross section, and have a rather flat minimum, which represents the optimum cross section. One curve of this type can be calculated for each of the four configurations, and the four optimum cross sections can be established. Of these, the point with lowest total cost is the *optimum optimorum*, and it represents the best configuration and cross section for the particular case studied.

Since many factors must be included in a thorough economic study, a computer program was developed for this purpose. Results of a typical study, involving the transmission of 750 Mw per circuit over 250 miles at 80 per cent load factor, are shown in Fig. 2. Transmission lines with single-expanded, dual, triple and quadruple conductors per phase are considered, all having the same transient and steady-state stability limit. The curves indicate the annual cost of transmitting power (as the differential from an arbitrary cost) versus the total aluminum cross section per phase.

It is clear that, in this particular case, which corresponds to the economic evaluation factors normally used by investor-owned utilities, the *optimum solution* corresponds to two conductors per phase, 18 inches apart, each having a cross section of about 1500 MCM. The next best solution would be to use three conductors per phase of about 900 MCM each. This would entail an increase in transmission costs of $120,000 per year. Single expanded conductors of 2900 MCM, and four conductors per phase of 650 MCM each, would be considerably more expensive—$300,000 and $220,000 per year, respectively. It may be concluded that appreciable savings can be obtained in EHV power transmission by selecting the most economic conductor configuration and cross section.

In certain cases, however, the conductor dimensions are determined by additional factors, which do not have a direct economic value. These factors are sleet prevention and radio noise, and they may require cross sections which are different from the most economic cross section, and therefore they increase the transmission costs.

In Fig. 2, the points marked "SP"

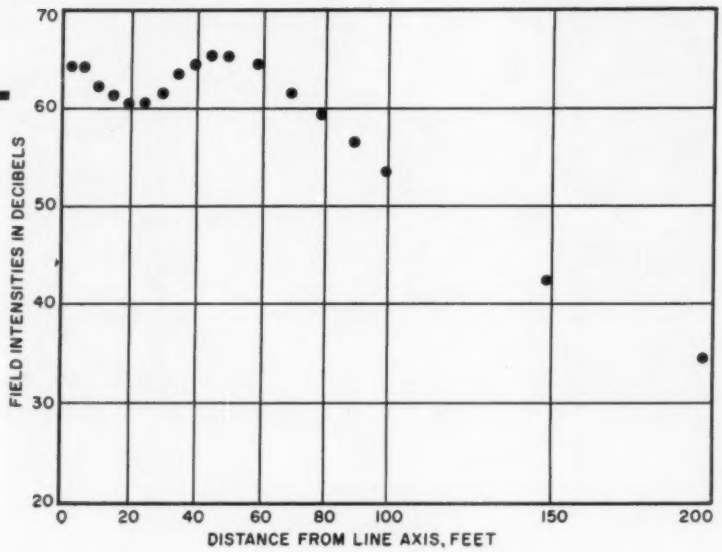


Fig. 3. Radio noise level of an EHV transmission line, versus the distance from the line axis, as plotted by the computer

correspond to the maximum cross sections which will still prevent sleet formation at surge impedance load, and the points marked "RI" correspond to the minimum cross section which will yield radio interference levels equal to those of the Swedish 400-kv lines, which are regarded as being very satisfactory. It is clear that in all cases, except quadruple conductors, it is not possible to satisfy both of these requirements simultaneously.

To prevent sleet alone, for instance, the cross section of the dual conductors would be reduced from 1500 to 1200 MCM, with a cost increase of about $40,000 per year. For this particular case, the radio noise level of the 1500-MCM conductors is satisfactory. If, however, special requirements would dictate a lower RI level (half of the level of the Swedish lines), it would be necessary to increase the cross section to 1750 MCM, with a cost increase of $40,000 per year.

Keeping constant the total cross section per phase, radio noise may be reduced either by subdividing this cross section into more conductors in the bundle, or by using expanded conductors. Both solutions are more expensive and may be evaluated as indicated above. In any case, this method allows the determination of the cost of RI in line design; and this cost may be compared to the cost of other methods for taking care of possible RI complaints; for instance, by modifying the antennas and receiving apparatus of the customers which are affected.

RADIO AND TELEVISION influence have become important in recent years, as more and more extra-high-voltage lines have been built near populated areas. The public is becoming more conscious of this problem, and more reluctant to grant easements for rights-of-way. The problem is complicated by the great variability of signal levels from the transmitting stations and of the disturbing interference levels, which depend greatly upon the weather, and also by the lack of industry and government standards. In general, a signal-to-noise ratio of at least 30 db (30 to 1 voltage ratio) is required to achieve good reception. Aside from the direct costs in settling complaints or in line design, excessive RI may lead to loss of good will and additional government regulations.

At the lower voltage levels, radio noise is generated mainly by line insulators and hardware in poor condition. Complaints are usually settled by identifying the source and removing the offending element. On extra-high-voltage lines, which are usually well maintained, practically all of the radio noise is generated by the conductor, and therefore can be reduced only by reconductoring the line, a very expensive solution.

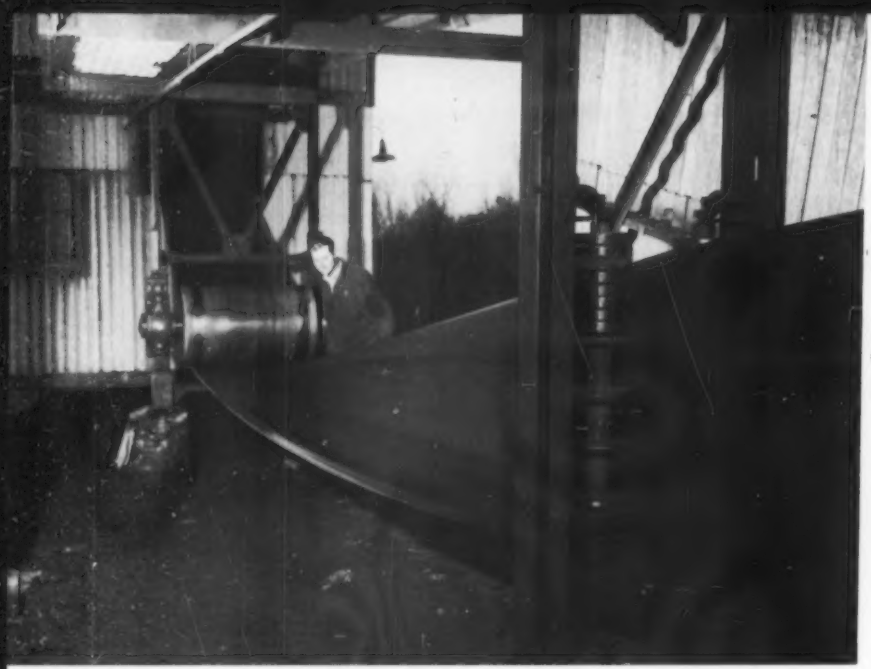
Energy distribution of conductor-generated corona pulses has maximum values in the AM broadcast frequency band (0.15 to 1 megacycle), and decreases rapidly as the frequency increases beyond this range. Consequently, disturbances to FM broadcasts and television are very low. The few recorded television interference (TVI) complaints are usually due to metal-to-metal discharges, as may occur from unloaded insulator assemblies, where poor contact exists between hardware of successive insulator units.

In 1952-58, Dr. G. E. Adams, of Schenectady, developed a rigorous analytical method for calculating the relative RI levels of alternative line designs. This method considers the generation of corona pulses from the conductor, the propagation and attenuation of these pulses along the conductors, and their radiation from the line to the antenna of the receiver.

The mathematical computations are very complex, and therefore are performed on digital computers. Our computer in Pittsfield starts from the line design data (voltage, conductor sizes, line geometry, etc.) and ends with a printed profile of the RI level, perpendicular to the conductors (Fig. 3). Since the RI levels are given on logarithmic (db) scale, it is seen that RI decreases quite rapidly with the distance of the antenna from the outermost conductor of the line, in first approximation, as the square (or the 1.5 power) of the distance.

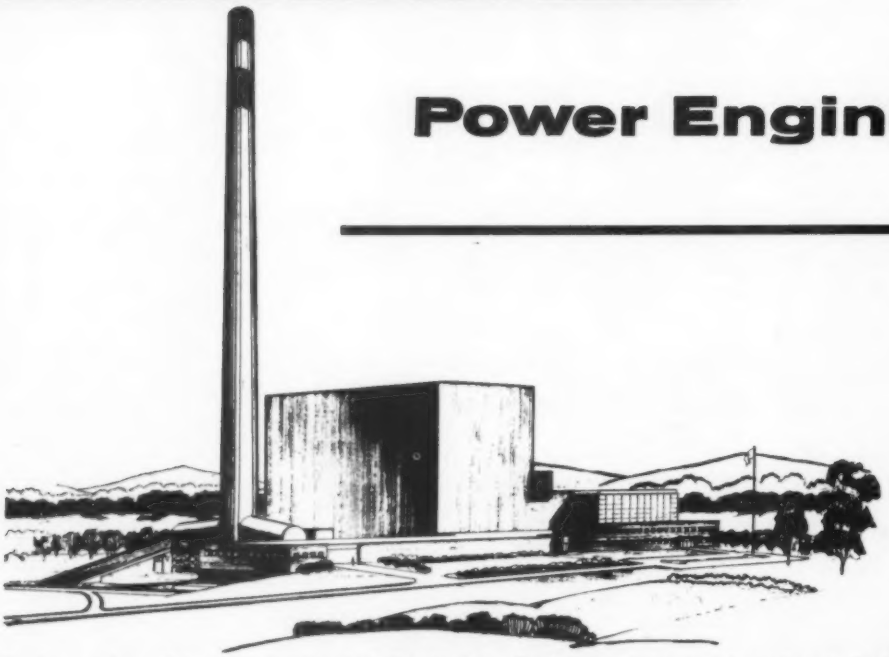
Using this approach, the RI level of a new line is predicted by using the known RI level of an operating line as reference. Work is now in progress to establish the calculation of RI on an absolute basis, using the data which is being obtained from measurements on Project EHV and other experimental and operating EHV Lines.

Editor's note: Next month, Dr. Abetti gives a detailed explanation of the design and operation of the famous Project EHV. END



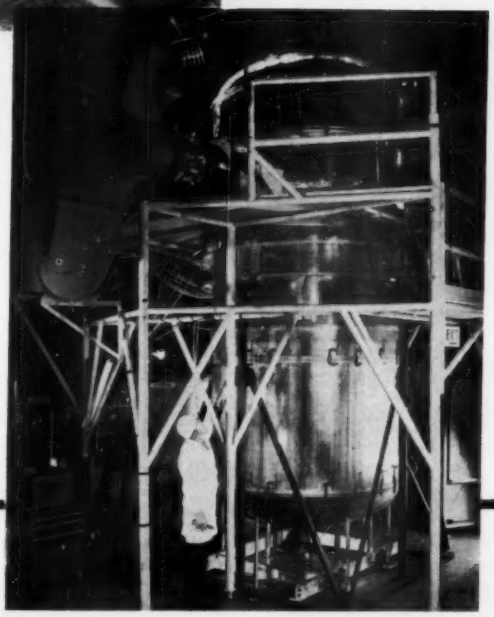
Conveyor belt takes new twist at Ohio Power Co.'s Muskingum River Plant to make clean side of belt ride on return idlers. This turnover system was developed by Goodrich, prevents build-up of tacky materials on idlers or pulleys. Twist pulleys at each end of belt flight provide the twisting action

Power Engineering's



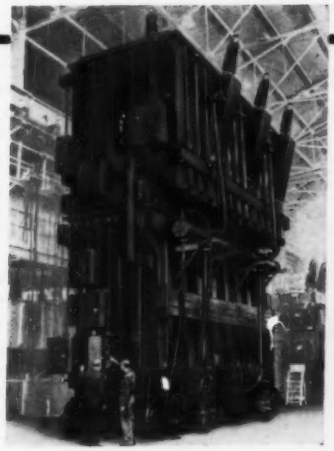
Bull Run Steam Plant of TVA will look like this, contain a 900,000-kw generating unit. Plant will cost $125 million

Engineers from 14 nations attended Combustion Engineering's first International Technical meeting in April



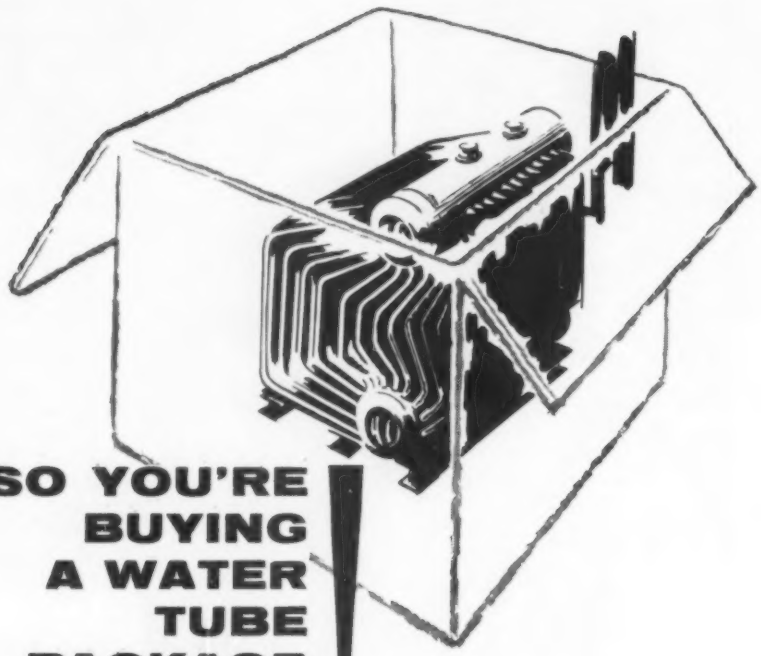
(Above) **Dome** of hexagonal steel panels at Wood River, Ill., houses tank car repair shop of Union Tank Car Co. Built without internal supports, dome has diam of 380 ft, height of 120 ft. (Right) **Half-size** transparent scale model of high-temperature gas-cooled reactor is being used experimentally by General Dynamics in building prototype

NEWS REEL



Giant test transformer will be used by Westinghouse to test units in excess of 600 kv. It weighs 440 tons, is 42 ft high, has 5775 different positions for 3-phase voltages, equal number for single-phase

New concept in use of air as bearing lubricant is development from Boeing. Externally pressurized step bearing has load-carrying shaft that spins freely on cushion of compressed air, and operates under both cryogenic and high temps



SO YOU'RE BUYING A WATER TUBE PACKAGE BOILER

A. F. Reilly, consulting engineer, sets down the important points

WE SHOULD MAKE IT CLEAR at the start that we are talking about *water-tube* packaged steam generators for higher capacities, pressures and steam temperatures than are normally associated wih fire-tube boilers. By *package* we mean a water-tube boiler that is shop assembled, perhaps with fans, burners and controls shop mounted, and shipped by rail or truck. Today these boilers are available from a few thousand pounds per hour up to more than 100,000 lb per hr—and pressure and temperature ratings are climbing steadily.

Main reason most people buy package boilers is just what you would expect—a minimum cost per pound of steam. This is unquestionably true and is largely responsible for the constantly growing share of the available market accounted for by package units (Fig. 1).

On the other hand, you may have severely limited space in your boiler plant and need all the steaming capacity you can squeeze into that space; or you may be building a new plant closer to raw material source or product market and require a new boiler plant at minimum cost. In either case you probably decided on one or more package boilers to get the most possible steam from the least possible expenditure of those precious building dollars.

You have probably been told that these boilers arrive so completely assembled that installation is a quick and easy and above all an *inexpensive* affair. This can be true—but is far from being universally so. The case can be cited of the boiler which arrived on the plant rail siding on Wednesday afternoon and was putting out 40,000 pounds of steam per hour by Saturday noon of that same week. But for every one like this there are many other jobs with far different and sadder stories. These sometimes require more months than the former did days to reach reliable maximum capacity output.

WHAT TO LOOK FOR. Many installation and operating problems can be avoided by some sharp vision in the *pre-purchase* period. There are some 17 manufacturers of water-tube package boilers in this country and, should you take the trouble to get 17 proposals, you could work up a king-

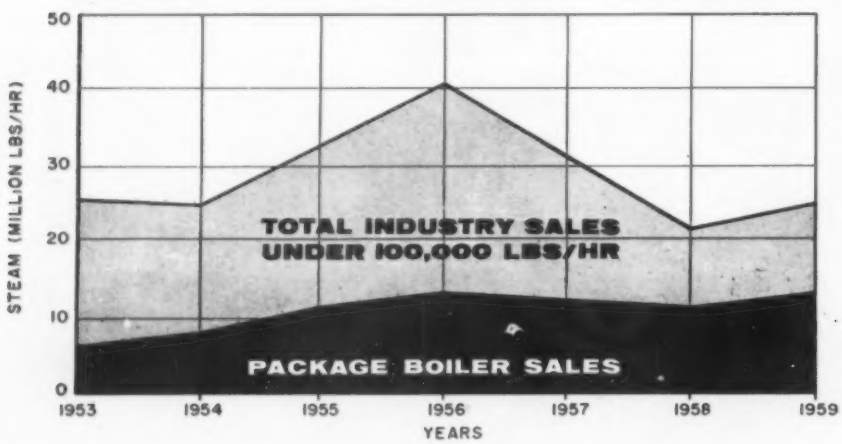


Fig. 1. Package boiler sales are increasing their share of market

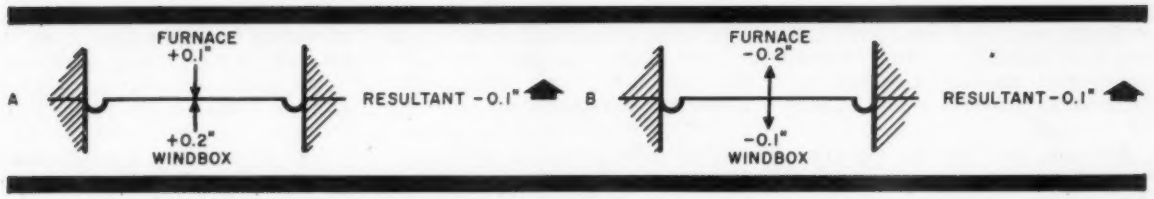


Fig. 2. Forces on air-flow measuring diaphragm for two different firing rates — same resulting force

size headache finding much difference in most of them aside from the number and color of pages. You could make up an evaluation sheet with 20 or 30 items and after filling in all the boxes still not have a clear-cut decision indicated. What's to be done?

As a starter, try a drastic step: forget about efficiency, heating surface and heat release rate — until you're down to a decision between the two best bids. This idea isn't as wild as it sounds because while efficiency differentials make for beautiful figures on an evaluation sheet you really have to stay on top of operation 24 hours every day to achieve the small differential you'll find. Many of us have bought cars whose makers claim (and can prove) high mileage figures; but how rare are those who drive at 30 mph on level roads without stopping for hundreds of miles!

I would pick reliability as my most important evaluation guide. Remember, a boiler that's down for repairs a couple of days every month can cost plenty of hard-earned production and maintenance dollars. How to evaluate reliability? Ask-the-man-who-owns-one is one good idea; in fact you should ask several, if possible.

Another way is to ask your prospective vendors to give you the story on things that count but are seldom found in proposals or evaluation sheets. How is the casing put together? How is it tested for tightness? What provisions are made for expansion? What quality of refractory and insulating materials are used? What kind, if any, of steam drying equipment is to be furnished?

Check your own and your neighbor's maintenance records for items that have put boilers down for unscheduled repair, and ask about these items. In short look for quality and careful design in the out-of-the-way places. When you find it there, chances are you'll find it in the obvious places as well; and most important, you will find reliability—the pay-off quality in any boiler.

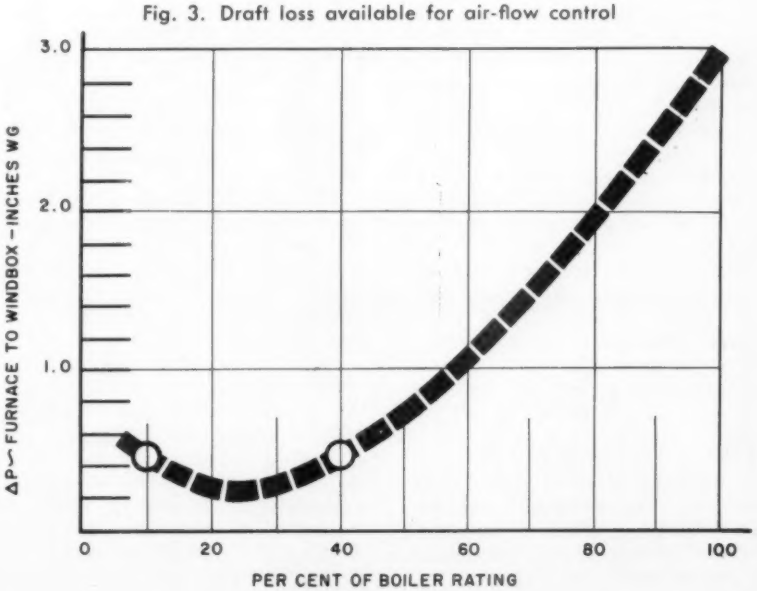
Be sure to look for a first-class burner and control system, because these are the dynamic — the constantly moving — parts of your steam generator. Don't mistake complexity for quality. No burner and control system is any better than the job done by the man who sets it up and maintains it. A good rule-of-thumb is to look for experience and reputation in the manufacturer and again, ask your neighbor. He'll be happy to tell you his experiences, and it's amazing how many other plant problems are solved by these inter-plant visits.

HOW TO BUY. Here's a quick checklist that may be helpful in buying your boiler. It doesn't include standard purchasing procedure but just a few pointers too often overlooked in this market:

1. Don't buy on price alone.
2. Check the quality of service. If you don't get top-notch service on start-up and later on when you need it, you obviously can't get full value from your buying dollar, or from your fuel dollar in many cases. This is another point you can check with your neighbor.
3. Buy in time for your need. Don't put off purchasing until the insurance inspector condemns your last boiler. Your supplier can't possibly do the job he should if he is rushed beyond reason. Figure 1 will show you that buying in this market is predictably cyclic, and you can sometimes save real dollars by buying in advance of your actual need at the bottom of a cycle when boiler shops are slow.
4. You can save dollars and time —if you engage a consulting engineer or have an adequate power engineering department — by simply forgetting that you ever heard of "unit responsibility." (Before I go further let me make it clear that the following does not apply to the package in which the boiler manufacturer also makes the burner and control sub-assembly).

So far as I have been able to determine, unit responsibility does only one thing for the purchaser. If you have trouble with your new steam generator you can sit back and say, "Mr. Boiler Manufacturer, this is all yours—you fix it." Again unit responsibility pays off; or does it? The trouble is there, and you're not making steam, or perhaps you're not making it as efficiently as you

Fig. 3. Draft loss available for air-flow control



should. Eventually the difficulty is remedied and I, for one, don't believe it is accomplished much faster because of unit responsibility. So you may have paid out good money for nothing.

When you ask the boiler manufacturer to assume responsibility for the burner and control system you expect to pay for this service and obligation. It might cost you $2000 or $3000 to have the boiler manufacturer decide whether the boiler or burner-control system is at fault before someone starts to fix it. If you have competent engineering talent working on your installation (which you certainly should have) you can make the same decision for nothing.

I have said that you can save time as well as dollars by dividing responsibility. With a separate purchase of the burner and control system all the vital information required for proper design goes direct from you to the equipment manufacturer. The shipment comes directly to your plant and does not involve delay of boiler shipment for mounting of burner equipment. Start-up dates can sometimes be advanced four to six weeks by using this procedure. Direct transmittal of information saves mistakes by excluding a third party who must receive, understand, transcribe and pass on information. Then, too, we should consider that burner people ought to be more sensitive to possible peculiarities of your plant design that are likely to cause burner and control problems.

A word of caution—don't overdo. It is wise to buy burner, fan, windbox and control system as an integrated unit if possible. Integrated here refers to the design. There's no reason why the fan or control panel, for instance, cannot be shipped separately if it makes sense to do so. These components are so mutually interdependent that separation is often a very risky business. Selection of an experienced manufacturer almost assures compatibility of burner to boiler furnace so that this basic separation is not so delicate.

5. Buy a performance test. To my way of thinking it is very inexpensive insurance. For a few dollars you can make certain that you have received what you thought you bought. It does not seem unreasonable to arrange terms retaining 10 per cent of contract price until performance guarantees are met, *provided* that you are fair enough to have all phases of your installation in proper condition so that tests may be run within a reasonable interval after shipment of equipment.

Don't tackle a package boiler purchase or installation without competent engineering assistance.

Putting it concisely, the package boiler is a fine investment when it is properly bought, installed and operated. It needs the same good care, preventive and routine, as any other valuable steam generator.

CASE HISTORIES. A complete discussion of difficulties encountered in package boiler applications would fill a volume, but some insight into the problem can be gained by considering a few actual case histories in the limited area of boiler gas outlet conditions. This area, incidentally, is very frequently neglected in practice, until operation — and trouble—begins.

Case I. Purchaser checks with boiler manufacturer and is advised that pressure firing means that an ID fan is not required, nor is a tall stack essential, merely one of sufficient height to avoid air pollution nuisance. Purchaser does not say why he asked.

Problem: Existing breeching is already loaded to maximum capability. The new boiler is tied in and as claimed, doesn't require any stack. There is enough spare fan head to push the gases on through the breeching and up the stack. It also pushes them back through the old negative draft boilers and *out into the firing aisle.*

Solution: A new breeching to a separate stack was added for the new boiler which was out of action for weeks.

Case II. Sometimes the stack and breeching are overly generous. Purchaser here decided that possible future low load condition would be improved by adding an outlet damper regulator to maintain a desirable constant pressure at the boiler outlet.

Problem: No provision was made to sequence the boiler outlet damper for light-off (automatically open the damper sufficiently for smooth light-off) with the result that puffs or flash-backs were encountered on each light-off.

Solution: Faced with the complexity of added switches and relays for sequencing, purchaser decided that possible future low load condition could be better handled by manual adjustment of the outlet damper, and removed the damper regulator.

Note: The overly high stack can be a genuinely tough problem in obtaining proper operation. Obvious solution (aside from regulators) is throttling the outlet damper to obtain optimum conditions at maximum load and locking damper in position. Reluctance to do this is often based on fear of incurring a charge of improperly restricting gas egress in the event of a furnace explosion. Only other commonly used remedy to date has been installation of large barometric dampers which, while they are usually effective, are generally frowned upon for use with boilers of this type. Use of damper regulators of course presents no problem or added complexity except on "fully automatic" boilers.

Case III. Metering combustion controls is frequently suggested as a measure to overcome the effects of high and varying negative pressures at the boiler outlet. Effects of variable winds are sometimes indicated by fluctuations of several tenths of an inch water gage in high stack installations. Low stack arrangements often show a wider range of fluctuation and sometimes draft reversals are encountered because of the combined effects of variable winds and nearby structures.

One interesting case history involved metering controls, a high stack and a requirement for wide burner turn-down.

Case IV. Metering controls were applied to an oil-fired unit with a turn-down requirement of more than ten to one and an individual 150-ft stack.

Problem: As the firing rate was decreased, a point was reached where the stack draft effectively took over from the forced-draft fan (this was a pressure-fired installation). At lower firing rates, therefore, a reversal in the direction of forces on the air flow metering diaphragm was encountered. Because of the influence of the stack at these lower firing rates, it was found that furnace pressure was higher than windbox pressure, as would be the case in natural-draft firing.

The interesting thing about the situation can be seen from a glance at Fig. 2, which shows that the resultant force on the air flow measuring diaphragm has the same magnitude and direction at two entirely different firing rates (*A* at 40 per cent rating and *B* at 10 per cent rating).

Naturally, the air flow controller could not "know" at which of these ratings it was supposed to supply air for combustion. The curve, Fig. 3, of measured differential between furnace and windbox vs. boiler load

Continued on page 83

ELECTRIC POWER FROM GAS JETS

Dr. D. J. Harris, lecturer in electrical engineering at University of Sheffield, England, provides a clear treatment of MHD fundamentals

NEARLY 100 BILLION kilowatt-hours of electrical energy are generated each year by the United Kingdom Central Electricity Generating Board, and the demand is steadily increasing, yet the over-all efficiency of a modern power station is little more than 30 per cent. Any method of raising this efficiency would obviously be of tremendous importance.

Major loss of energy in the conventional generation process occurs during the conversion of thermal to mechanical energy; that is, in the turbine stage. This loss can be reduced by increasing the temperature of the "working fluid," usually steam, but there is a limit to progress in that direction. The concept of omitting the turbine stage, the working fluid being made electrically conducting so that it can interact directly with a magnetic field to generate electric power, is not new. Inventors were attracted to its potentialities nearly 50 years ago, but experimental work following up these ideas has only recently been reported.

NEW JET TECHNIQUES. This recent revival of interest in such a generation method has been due largely to the development of new materials and jet techniques. A scheme which dispenses with both turbine and conventional electric generator, and allows direct transfer of energy from the working fluid to an electric circuit, has the advantage of simplicity and the possibility of a high efficiency, since no moving parts at high stress are required and therefore high-melting-point materials, such as ceramics, can be used.

A schematic of the generation process is shown in Fig. 1. The gas is preheated and then raised to a high temperature in a combustion chamber, expansion through an appropriate convergent-divergent nozzle resulting in a high directed velocity. The high temperature could be obtained by burning pulverized coal or fuel oil in the gas as in a normal jet engine, or by using a high-temperature nuclear pile.

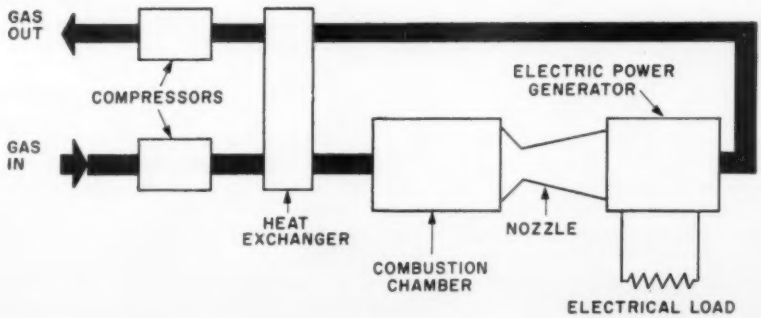
Interaction between the high-velocity jet and a magnetic field is obtained by converting the gas to a poor but significant electrical conductor. If the interaction is sufficient, the gas will be braked by the magnetic field, with a subsequent transfer of energy from the jet to an electric circuit when conditions permit. Thus, the electrically conducting jet itself performs the function of the conductor in a normal electric generator.

High-velocity-gas-jet techniques are well established, and jet conditions of gas velocity 100 m/s (3300 fps), temperature 2000 C (3630 F) and pressure 0.1 atm are typical of what can be achieved. In the production of a suitable jet, there is a choice between a closed and open cycle, and between continuous and pulsed operation. The closed cycle uses indirect heating of the gas, which is recompressed at the end of the generation process and returned to the heating chamber, whereas fuel combustion takes place directly in the air, which subsequently forms the jet, in the open cycle.

Although the obtainable temperature in the closed cycle is lower than that in the open cycle, the closed cycle allows a free choice of the gas used and does not result in the products of combustion (many of which are electron-attaching and reduce the conductivity) being present in the jet.

PULSED OPERATION allows higher operating temperatures during the pulse, and makes possible new induc-

Fig. 1 illustrates a theory of generating electric power from gas jets, a process explained in text



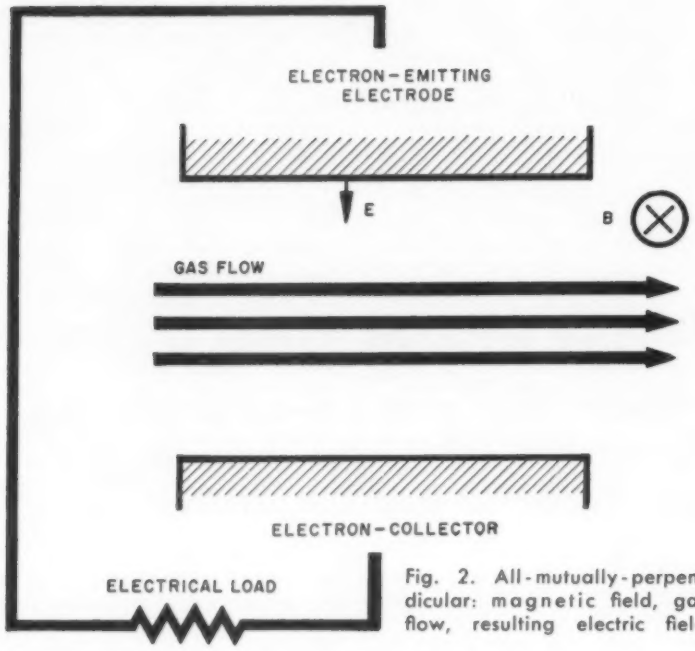


Fig. 2. All-mutually-perpendicular: magnetic field, gas flow, resulting electric field

tion-energy-transfer schemes. Valveless resonator combustion chambers —"organ-pipe jet engines" as used in the V1 flying bomb—would allow operation at hundreds of cycles per second.

Initially, the gas jet consists of uncharged gas molecules only, and there would be no interaction with electric or magnetic fields. Electrically charged particles must therefore be introduced into the gas jet to make it electrically conductive, and several ways exist for doing this. A beam of energetic charged particles, for example, electrons, injected into the jet, will undergo ionizing collisions. An electron beam of 250 kev energy will result in only about one in a thousand of the jet particles being ionized, however, for a jet cross section of one square meter, even if the process were completely efficient.

Very high electric fields in the jet region would result in the initiation of a gas discharge and charged-particle production. High-frequency alternating fields have the advantage of requiring no electrodes in the gas. Alternatively, a high direct voltage on thin wires could be used to produce ionization, as in an electrostatic precipitator. Both beam and high-electric-field methods require the feedback of electric power from the output of the generator. For a typical air jet, even if all the energy in the jet were used efficiently for ionization, only three per cent of the gas would be ionized. Thus, the degree of ionization practically realizable is restricted to a fraction of one per cent.

A third possibility is to use the high temperature of the jet to produce thermal ionization of some of the jet molecules. For the usual jet constituent gases, this thermal ionization is negligible. If low-ionization-potential elements, such as potassium, sodium or cesium, are introduced into the jet, however, this thermal ionization can be appreciable. Calculations based on the Saha equation indicate that, for a one per cent addition of potassium to an air jet and a temperature of 2000 C (3630 F), a degree of ionization of 0.1 per cent is obtained, corresponding to an electrical conductivity of about 50 mhos/m (0.83×10^{-7} mhos/mil-ft).

By comparison with a metal, this is a poor conductivity, being similar to that of an electrolyte, but a conductivity much in excess of this cannot be expected; and if the generation process is to succeed, use must be made of this medium as the moving conductor.

TRANSFER OF ENERGY. Charged particles of both polarities are introduced in equal numbers by the methods outlined, and the jet remains electrically neutral. Magnetic fields, rather than electric fields, have therefore been mainly considered for interaction with the conducting jet. Schemes suggested have been either charge-separation or induction methods. In the former, a transverse magnetic field is used to separate the electrons and positive ions, an electric field being set up in a direction perpendicular to both jet and magnetic-field directions. This is illustrated in Fig. 2.

Generation method is similar to that of a conventional electric generator, an electric current through the gas corresponding to the conductor current and resulting in a braking force on the gas. Electrons have to be introduced continuously from one electrode to maintain neutralization in the gas and give current continuity in the output circuit. The electric field produced in the generator is calculated as usual as the product of conductor velocity and magnetic flux density; for example, for a flux density of 1 weber/m^2 (64,500 lines/sq in.) and a jet velocity of 1000 m/s (3300 fps), an electric field of 1000 volts/m is generated. Generator configurations using an annular jet and a radial magnetic field, in which the generated e.m.f. is in the axial direction, have also been suggested.

Induction generators rely on coupling between circumferential alternating currents set up in the gas and induced currents in an external coaxial coil. No electrodes are then required in the jet itself, which is a great advantage since thermionic-emission problems are obviated. The circumferential gas currents may be produced by an applied alternating radial magnetic field, when the jet would need to be annular with a central axial pole-piece.

An attractive alternative is to use a pulsed jet with the gas moving along the axis of a large air-core coil through which a current is passing. If the product of jet conductivity and pulse frequency is sufficiently large, there will be a change of effective inductance of the coil, owing to the reduced penetration of magnetic flux into its core area when the pulse of conducting gas is introduced. An inductance change of a few per cent can be expected at pulse frequencies of several hundred cycles per second.

If a direct current is initially flowing in the coil, this inductance change corresponds to a change of stored energy, and it can be shown that there is a net extraction of energy from a pulse of the jet when it passes through the coil. The currents and magnetic field are shown in Figure 3, together with their variation with time as a pulse of conducting gas passes through the coil.

An alternative scheme uses the

parametric principle, in which the inductive coil is made to resonate with a capacitor, the resonant frequency being half that of the jet-pulse repetition frequency. The periodic change of effective inductance, which is increased at coil-current maxima and decreased at coil-current zeros, results in a build-up of energy in the resonant circuit and dissipation in any load placed in series with the coil and capacitor. This latter scheme has the advantage that it is self-exciting, provided that the circuit resistance is less than the product of jet-pulse frequency and inductance change.

A practical generator of the variable-inductance type would consist of a tube of high-melting-point insulating material, for example, silica or ceramic, through which the jet pulses would pass, the energy-transfer coil being situated on the outside of the tube. A series of coils might be necessary to give effective energy transfer. The scheme offers the advantages of great simplicity, high working temperature and low thermal losses from the jet.

It must be appreciated that a very small fraction of the jet molecules are ionized—considerably less than one per cent, and that it is only the charged particles that interact directly with the magnetic field. For a generator with useful efficiency, there must therefore be an effective mechanism for transferring energy from the uncharged to the charged particles, and hence to the electric circuit. It will be the electrons which are most effectively braked by the magnetic field, but, owing to the large mass disparity, they will not be very effective in causing transfer of energy from the gas molecules. Positive ions will be much more effective in this energy transfer, but their relatively low mobility will result in their being less effectively braked.

It may well be that both electrons and positive ions will play an important role, the former in the interaction with the magnetic field and the latter in reducing the kinetic energy of the jet-stream molecules. Coulomb attraction forces between the electrons and positive ions may act as a link between the two processes. The electric field associated with this separation of charge may well be too great to be withstood by the gaseous insulation, however, and this could set an upper limit to the rate at which energy can be transferred from the gas jet.

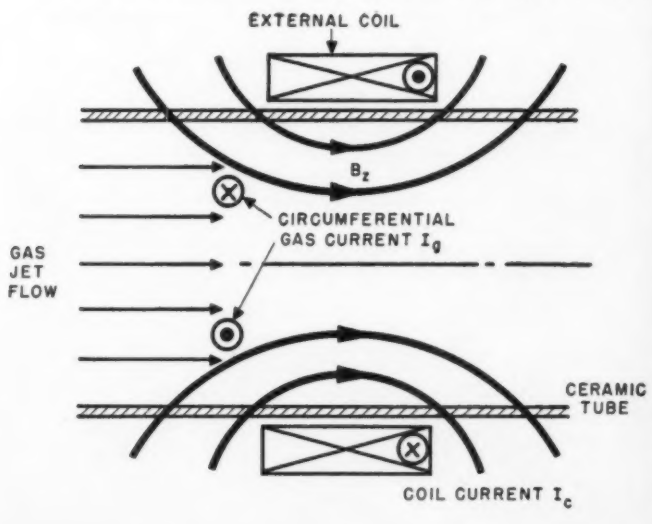
GENERATOR FEASIBILITY. There is little doubt that a suitable gas jet could be set up for continuous or pulsed operation, that a fractional ionization of tenths of one per cent could be achieved in the gas, and that the energy of this small fraction of the gas particles could be transferred to an electric circuit by one of the schemes outlined. The eventual feasibility of a practical generator will depend largely on whether the energy can also be transferred from the uncharged particles, since otherwise the efficiency of the generation process cannot be greater than the percentage ionization.

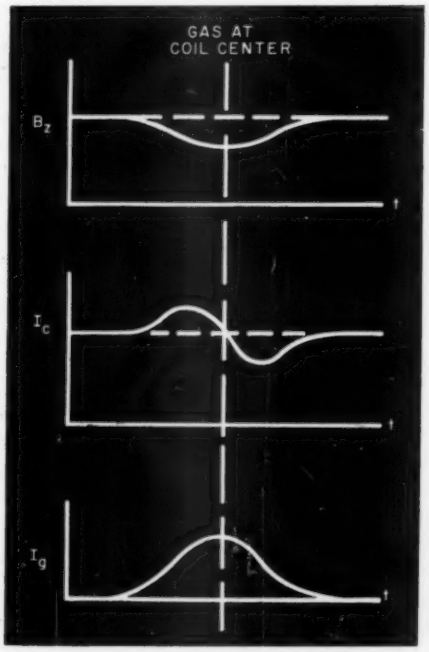
No positive answer to this question is at present available. Experimental generators, producing 10 and 1 kw respectively, have been built and reported by two American firms. Both generators use the simplest configuration of a continuous jet and a transverse magnetic field, but the degree of ionization of the jets has not been published.

Active interest in the great possibilities of the scheme has now been aroused in the United Kingdom. Several different types of experiment need to be performed. On a laboratory scale, the effectiveness of the different jet-braking methods could be investigated, using jets of partially ionized gas of high velocity but lower power; and there is necessity for measurement of fundamental collision properties (cross sections and type of elastic scatter) for collisions between particles having a relatively low directed velocity; that is to say, only of the order of the velocity of sound.

There is also need for experiments of the pilot-plant type. While a great deal more information is required before the feasibility of a practical generator can be assessed confidently, the advantages that such a generator could bring are such that there is every inducement for further work to be done. END

Fig. 3. Variations of currents and magnetic field with time as a pulse of conducting gas passes through the coil





PORTABLE COAL CRUSHER PERMITS ON-THE-SPOT SAMPLING

Unit powered by gasoline engine mounted on pickup truck for mobility, efficiency, convenience

RINGGOLD COAL MINING Company, of Kitanning, Pennsylvania, does no mining itself, but serves solely as a coal broker. Despite a multiplicity of sources, Ringgold must attest to the quality of the coal it delivers, and assure that the high-volatile bituminous coal meets Btu specifications every time. This requires close quality control over numerous independent operators.

Volume of coal to be sampled created an economic problem in analyses. The tonnage of coal handled just for sampling was high. Cost per sample, considering that coal had to be crushed, split and analyzed by independent concerns, ran high. Something had to be done to reduce sample tonnage hauled, reduce cost per sample, increase over-all samples and achieve a better quality control and a truer analysis of coal.

In 1960 a Sturtevant machine was acquired which receives coal to be sampled, crushes it and diverts a five, ten or fifteen per cent sample. Since the diversion of sample is directly from the feed, the sample is truly representative. The sampler-splitter takes that homogeneous percentile and diverts a further five, ten or fifteen per cent of it for laboratory analysis.

However, it was not desired to install the sampler at the Kitanning headquarters nor in a lab like the one which had done the crushing for years. The company wanted instead to achieve on-the-spot—at the mine, along the road, at point of delivery —coal crushing and splitting which would produce an immediate sample of the coal for analysis at independent laboratories. This meant that the standard, three-horsepower crusher-sampler would have to be made "portable."

It was determined that the sampler could be independently powered by a gasoline engine instead of the electrical motor and could then be located anywhere. A ¾-ton pickup truck proved to be a happy choice.

Now, with the truck-mounted crusher, which was installed late in 1960, samples are taken at mines and tipples. The company is studying the economic feasibility of sampling at point-of-delivery for local

Coal to be sampled is snagged from loading chute

Gasoline engine-powered sampler on pickup truck

customers, at point-of-shipment for distant customers. This would give a moisture reading on-the-spot, a true ash content determination, a rapid, small lab-size sample for analysis. Seventy-five pounds of coal introduced to the sampler produces an ultimate three-and-a-half-pound sample.

The truck can sample at the company's five most distant suppliers and tipples in a working day, allowing 90 minutes between stops and the crushing of half a ton of coal at each. The half ton yields a 150-lb initial sample which, when fed to the splitter, is further cut to about seven pounds of tiny homogeneous particles for laboratory analysis. The truck does not always take this one sample and move to another area, though. It may remain at a single mine for a day, taking channel samples, mined coal samples or making other checks.

THREE-INCH AND SMALLER bituminous chunks may be taken and crushed to sizes of six mesh and finer, with a large percentage of 20 mesh and finer, at a rate of as high as a ton an hour. As the coal is fed into the unit, it is immediately gripped by a revolving coarse crushing nut and roughly smashed against stationary top liners before gravity-passing to a revolving, fine-toothed crushing disc and stationary liner. This gradual multi-step reduction process, incorporating both rotating and crushing actions, assures a thoroughly mixed, homogeneous, finely disintegrated representative cross-sample of the coal passed to it, including, of course, the correct proportions of impurities. The automatic splitter further splits the sample, taking five per cent from the five, ten or fifteen per cent sample discharged from the crusher-sampler. This assures lab-size samples. The remaining coal is sloughed off to a coal pile nearby.

To keep the sample chemically stable, the crusher operator tightly seals it in a screw-top metal can. This assures no loss or pickup of moisture between sampling and analysis.

Gasoline engine drive permits placing the sampler on other trucks or even leaving it at one point-of-use for a period of time. It allows even further diversification than would be expected at first study. END

Coal to be analyzed is only small fraction of initial amount fed to sampler. Metal can will be sealed tightly for proper moisture check

Coal which is fed into unit but not ejected to sample pile is discharged through chute on side of the specially adapted truck

RADAR-RELAY-CAMERA TEAM PINPOINTS HV LINE FAULTS

Transmission line faults located and photographed in less than 150 milliseconds

AN ELECTRONIC FAULT LOCATOR developed in Scotland is able to record and locate a fault between the time a relay detects it and when the breaker opens. Field tests on the North of Scotland Hydro-Electric Board trans-mountain transmission lines and South of Scotland Electricity Board facilities proved that the unit can pinpoint a fault to within two line spans.

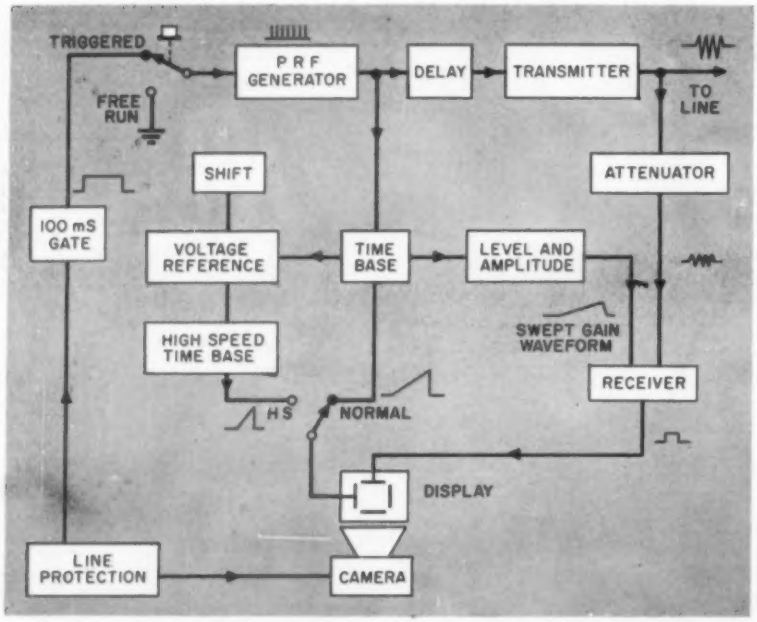
Developed originally to detect the position of arcing faults, ice build-up and conductor oscillation on 132- and 275-kv lines, the locator also works well on higher and lower voltage lines.

The locator operates on a pulse system. The transmitted signal is generated within the locator and consists of 400-v peak to five microsecond pulses spaced at approximately five millisecond intervals. Main (carrier) frequency is 1000 kc.

These pulses are coupled to the line and are transmitted along its entire length. All discontinuities on the line represent a change in the transmission characteristic and cause a reflection. These discontinuities may be small, as in the case of towers, or large, as in the case of an arcing fault. The reflected pulses are received by the locator and displayed on a cathode ray tube for either visual or automatic photographic record.

Fault recording must be carried out within the time interval between the operation of the first fault relay and the opening of the main breaker on the line. This interval is about 150 milliseconds (it can be reduced to 50 milliseconds with high-speed protection). However, the initial striking of the fault arc produces transients which must not be recorded. These take some 20 milliseconds to die out. The camera shutter takes approximately the same time to open after being triggered, providing this delay.

Fig. 1. Ferranti line fault locator has high-speed time base



HERE'S HOW the locator works: An impulse from the fault relay in the line protection circuit triggers the camera, and a 100-millisecond gate is produced. (See Fig. 1.) This gate causes the pulse repetition frequency generator to run for this time at a frequency of about 200 pulses per second. The generator performs two functions. First it triggers the time base and then, after a small delay to allow the time base to start, it triggers the transmitter.

Pulses returning from the line pass through the attenuator, to prevent limiting, and then through the receiver where they are amplified, detected and finally displayed on a cathode ray tube. Throughout the length of the time-base sweep, re-

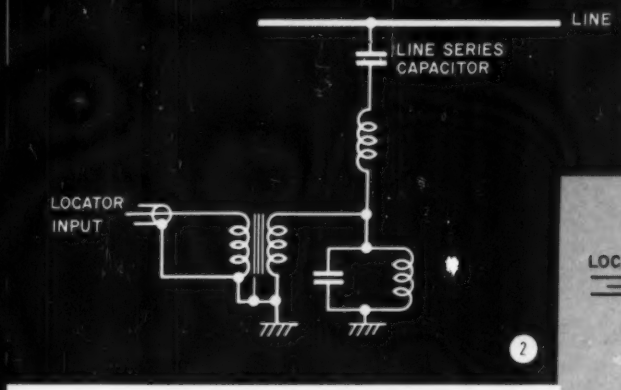


Fig. 2. Typical carrier coupling circuit uses series capacitor and inductance at 1000 kc resonance

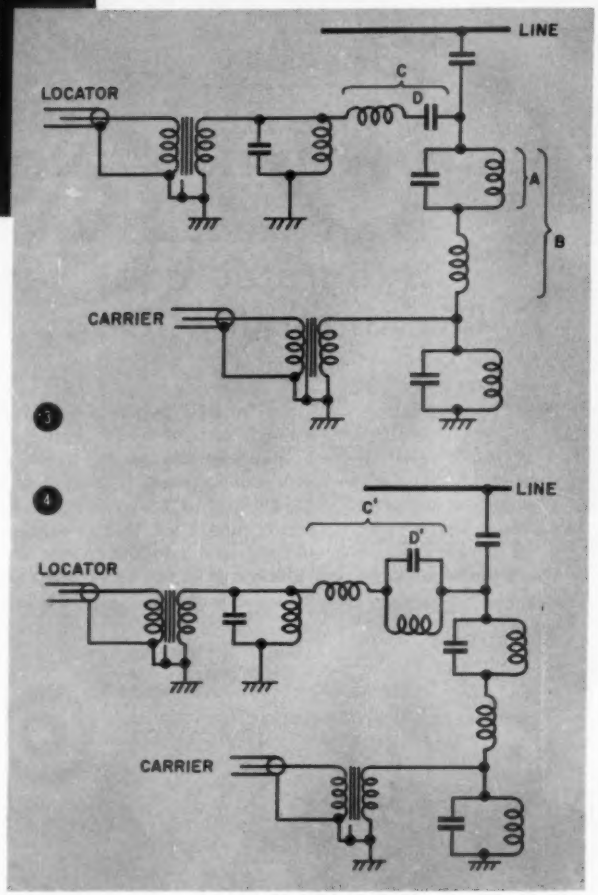


Fig. 3. Parallel resonant circuit A rejects locator frequency; B admits carrier frequency

Fig. 4. Parallel resonant circuit D′ isolates carrier frequencies too high for capacitor to isolate

ceiver gain is varied to compensate for line attenuation, thus presenting a line trace of constant amplitude. This is done by the level and amplitude circuit which produces a swept-gain waveform which can be varied to suit a given line.

A separate high-speed time-base facility enables the operator to examine a line more closely. This is set to scan about 15 miles of line. The 15-mile scan can be moved to examine any given section of a long line, by means of the shift control via the voltage reference circuit. The main time base can also be preset so that the trace covers line lengths varying from 20 to 100 miles.

THE CAMERA, a Shackman Autocamera, Mark III, automatically re-sets after photographing a fault trace. It allows several faults to be recorded and located before it is possible to develop and examine the film.

Permanent features of the line which appear on the cathode ray tube provide range calibration. Accuracy is one per cent of line length or 3000 ft, whichever is greater. Minimum range for fault recording is one mile and, depending on local line conditions, maximum range lies between 80 and 100 miles.

COUPLING METHODS VARY. A series capacitor is the safest and most reliable coupling method. Where no coupling exists, it is only necessary to use coupling capacitors with a series inductance tuned to resonance at 1000 kc, together with a suitable shunt network to give a reasonable bandpass filter as in Fig. 2. Where coupling capacitors exist for carrier protection circuits, these can also be used to couple-in the locator.

In all line coupling systems it is necessary to prevent radio-frequency power being fed back into the busbars or transformers at the sending end of the line.

Standard procedure is to use a tuned rejector circuit (line-trap) between the coupling point and the station end of the line. When the locator is coupled to the line, a rejection circuit with two tuning points — carrier frequency and locator frequency — is needed.

Two slightly different methods can be used to couple both carrier and locator frequencies without mutual interference. In Fig. 3, "tank circuit" A is tuned to reject the locator frequency, and circuit B as a whole acts as an inductance which is in series resonance with the line coupling capacitor at the carrier frequency. Thus carrier coupling is virtually as in Fig. 2.

In Fig. 3, circuit C accepts the locator frequency and capacitor D is small enough in capacity to reject the carrier frequency. This method is not applicable at the higher carrier frequencies since D cannot be made small enough to reject them adequately.

At higher frequencies, the circuit in Fig. 4 is used. Here, D has been replaced by D′ which is tuned to reject the carrier frequency, while C′ still accepts the locator frequency.

The locator, developed by Ferranti Ltd., of Ferry Road, Edinburgh 5, Scotland, is designed for easy and simple operation in manned or unmanned substations. It has its own battery supply. The equipment's four units fit standard racking and provide good accessibility for maintenance. END

from mine to boiler

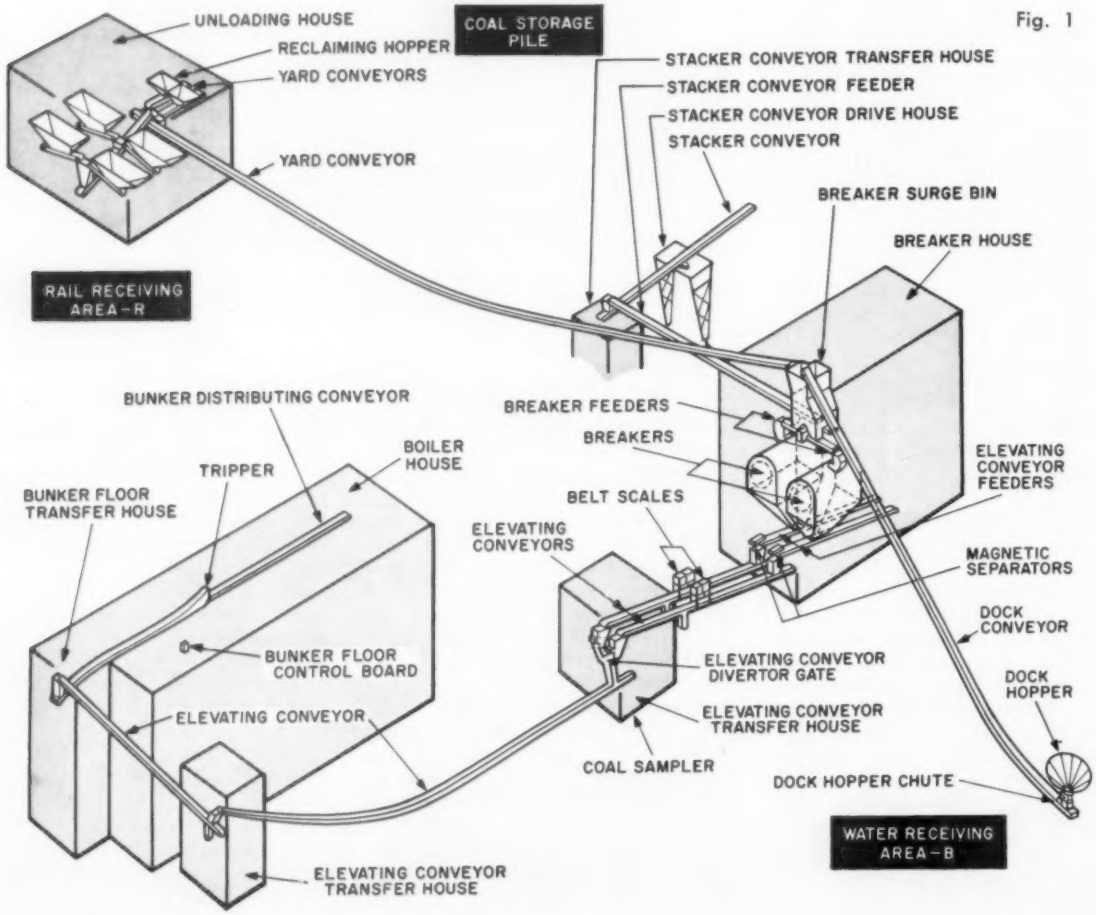
COAL CONVEYING AND CONDITIONING

is an exact art when it is part of an integrated coal-handling system, as A. S. Drummond, of Detroit Edison, here shows

FIGURE 1 shows a schematic arrangement of an integrated coal-handling system. Coal is received by rail in area "R" or by water at the dock area "B". Coal discharged into the dock hopper is transported by the dock conveyor to the breaker house where it is discharged to a surge bin. The coal required for immediate use in the plant is fed to the breakers by the breaker feeders, and the balance spills over from the surge bin to the stacker conveyor feeder and then to the stacker for deposit in a temporary storage pile.

The coal deposited in the stacker pile is moved into the storage area or may be returned to the breaker house to supply the plant needs. Rail coal and coal reclaimed from the storage area is fed into the conveying system at the unloading house or the reclaiming yard hoppers, Fig. 2.

Fig. 1



The unloading house hoppers are equipped with a heavy grating at the top of each hopper. This grating retains any large chunks of frozen coal, which are broken manually to a size that will let them pass out of the bottom opening and so prevent plugging. Use of frozen coal crackers, which are single roll crushers carrying long teeth that project into the hopper near the discharge opening, is another means of eliminating pluggage due to lump coal.

Variable speed feeders are used to control the rate at which the coal enters the system and for capacities required in large volume systems, belt feeders are necessary and they can be made reasonably dust tight. Vibration feeders and apron feeders are used in many installations of medium capacity or in special or space limitation cases. Feeders discharge to a conveyor which carries the coal to the breaker house, Fig. 4.

Rate of coal feed to the breakers, whether from the dock or from reclaim, is controlled by feeders from the surge bin. The breakers illustrated here are high capacity peripheral feed type, and Fig. 3 shows one half of a breaker and the feed section. Crushers are also used extensively for sizing the coal and require much less room than breakers. Breakers have a decided advantage in that they screen out the tramp iron by retaining it in the breaker from where it is removed periodically, whereas crushers are susceptible to damage from tramp iron.

Coal is normally sized by the breaker or crusher to pass 1¼-inch screen size for stoker use or for feed to pulverizers. For cyclone-fired units, the coal is crushed to a size of approximately 95 per cent through No. 4 mesh screen.

The sized coal is transported to the bunkers by a conveying system. Figure 5 shows an apron feeder supplying coal to a crusher which discharges to a bucket-type elevating conveyor. This type of equipment is ideally suited for elevating and conveying in medium-sized plants, conserving space and lifting the coal vertically. The upper horizontal run of this conveyor may empty directly into the bunkers, or if there is more than one row of bunkers, it may be at right angles to them and feed to several distributing conveyors which in turn feed the various bunkers.

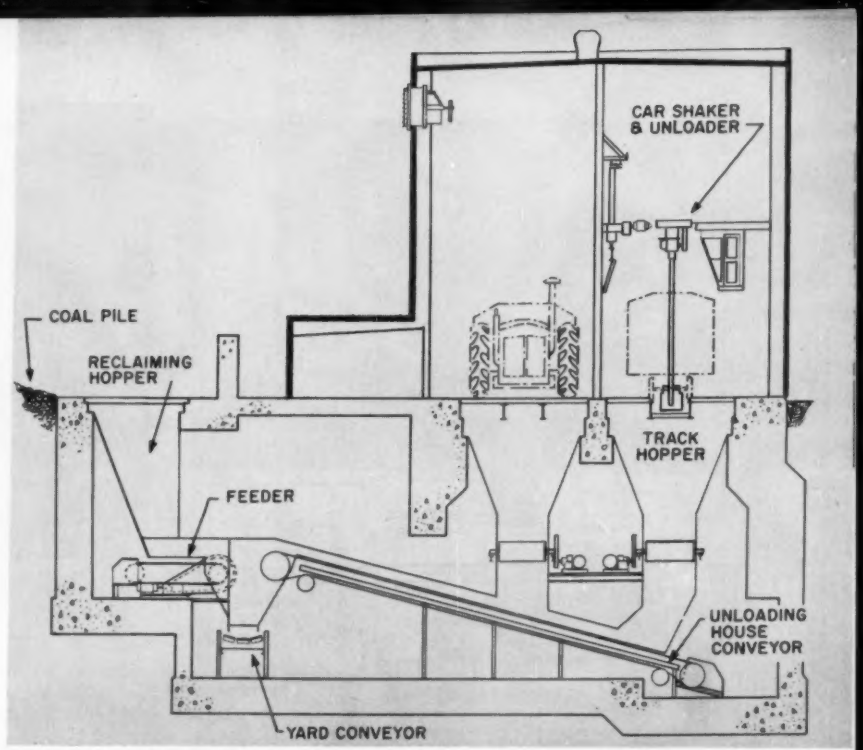
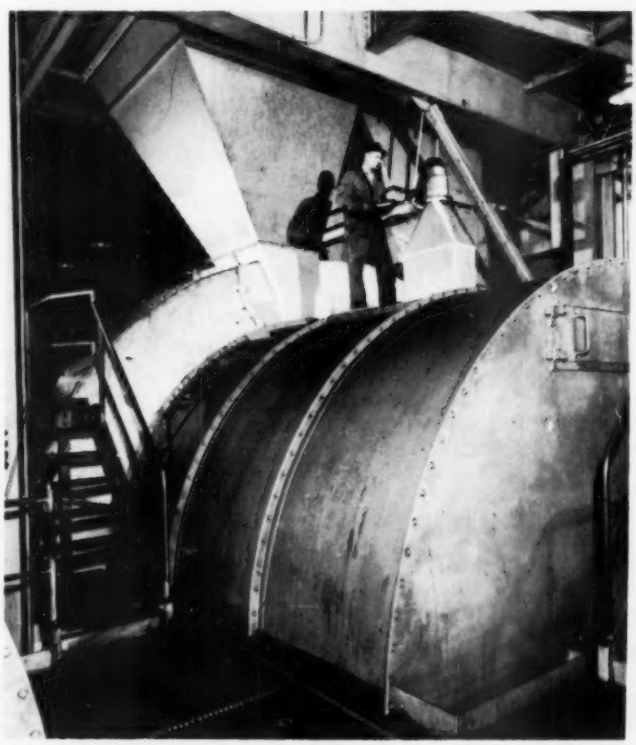


Fig. 2 shows section taken through unloading house

Fig. 3 shows one-half of a breaker and feed section



A belt type of elevating conveyor system as illustrated in Fig. 1 requires considerable distance horizontally to obtain sufficient rise be-

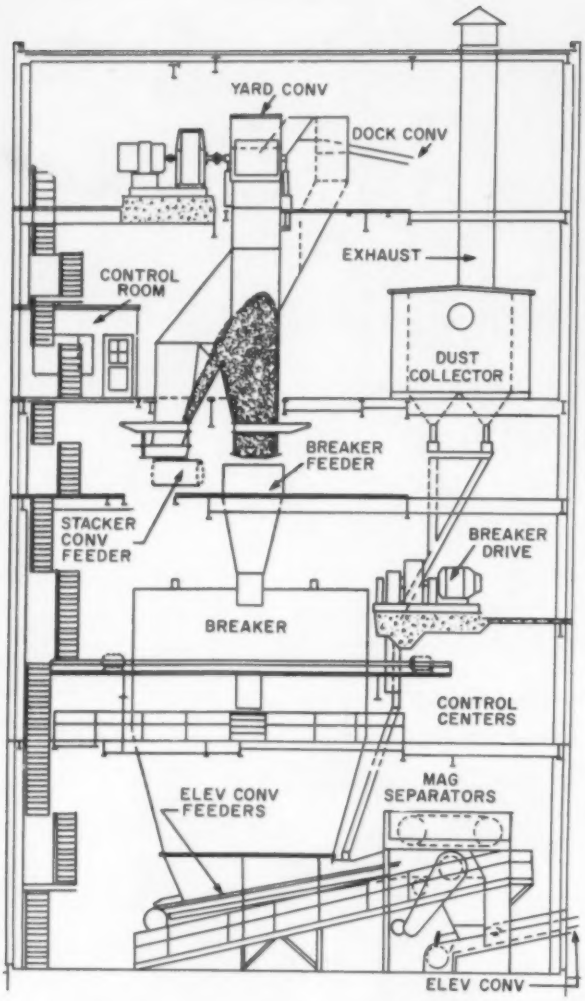
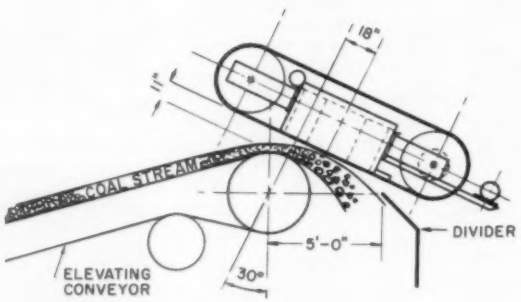


Fig. 4 is composite longitudinal section through breaker house

Fig. 5 (above) shows apron feeder, crusher, bucket carrier. Fig. 6, in-line suspended magnet



cause the angle of incline is limited to 16 deg, or a rise of 26½ feet in 100 feet of belt run or slope distance. Preferably 15 deg should be maintained because with steeper slopes the coal will slide on the belt and, when lightly loaded, the individual pieces will roll downhill and escape off the sides of the belt, creating a continuing clean-up problem.

IN ORDER TO REMOVE tramp metal from the coal and minimize the hazard of damage to belts, stokers or pulverizers, magnetic separators are installed in the conveying system. These may be in the form of magnetic head pulleys or magnets suspended above the belt and as close to the coal stream as possible.

Figure 6 shows one type of suspended magnet located over the discharge of a conveyor where the coal is exposed to the magnet when it is in a loose and falling condition, to permit more ready escape of metal. A rotating belt on the magnet carries the removed metal to a discharge point away from the coal stream.

With a magnetic head pulley, the removed metal is carried around the pulley and dropped into a hopper after the belt has moved it out of the magnetic field. Considerable coal fines are scraped from the belt and deposited with the tramp metal, and a vibrating screen is installed in the receiving compartment to return the fines to the coal stream and discharge the metal to a rejection point.

Weighing of the coal supplied to the plant is necessary for accounting purposes and to measure the performance of the equipment. Where coal is delivered to the plant by railroad cars the weighing may be obtained by track scales before the coal enters the conveying system. In modern large-volume plants scales are used in the conveying system or in the feed to the individual units of burning equipment. Figure 7 shows one type of scale used to weigh the coal on a moving belt and Fig. 8 shows a type used to weigh coal to individual units.

Coal-sampling is necessary to establish the heating value of the coal for use in combination with the weight to determine the plant performance, as well as evaluation for purchasing purposes and in some cases for establishing the rates for power.

The sampling may be performed in several ways, either manually or automatically, but the amount and method of handling is given in test codes. Where all coal is received by rail, samples may be obtained when the car is being dumped, by use of sampling tubes located in the falling coal stream.

In a typical arrangement for ob-

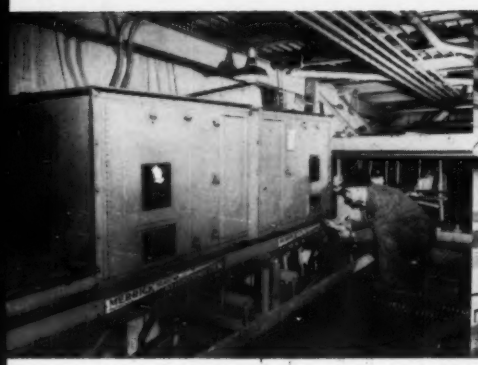


Fig. 7. Scale to weigh coal on belt

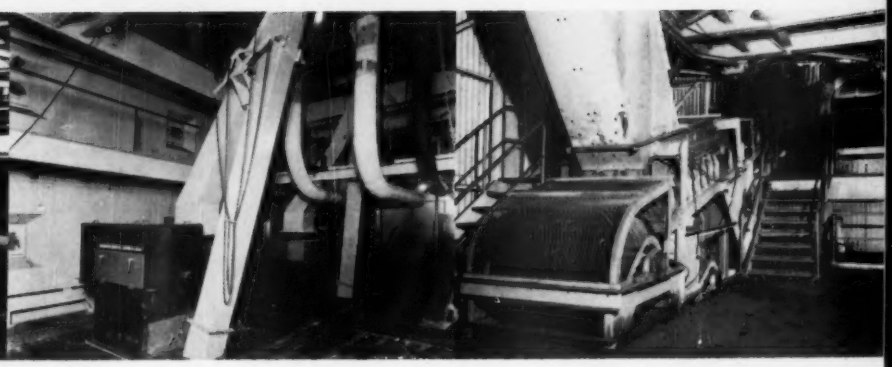


Fig. 8 Scale weighs to individual units

Fig. 9. Conveyor and transfer point

taining a sample from a conveying system, a moving cutter traverses the coal stream and diverts a portion of the coal to a sample hopper. The enclosed drag link conveyor elevates the sample to the top of a storage bin where it passes through a sample crusher to the bin. The crusher sizes the coal to 95 per cent through No. 4 mesh screen. The sample is fed from the bin by a vibrating feeder to a secondary sample cutter and is then further reduced by passing through a riffle box to obtain the size of sample desired for laboratory analysis.

THE CONVEYING SYSTEM delivers the coal to the distributing conveyors located on the bunker room floor. A series of conveyors may be required to elevate the coal because of limitations in the practical length of belt run due to changes of direction or belt tension for power transmission. Figure 9 shows an elevating conveyor at a transfer point. The close spacing of the impact-type idlers at the loading point maintains the belt position and shape and so inhibits coal from escaping at the sides of the belt.

The distributing conveyors discharge the coal to the bunkers by means of a belt tripper car or a shuttle belt. The tripper car, Fig. 10, raises the belt off the conveyor table and reverses it over a pulley at the top of the car. Coal discharges to a hopper that feeds to pant-leg chutes at each side of the car. The belt is again reversed over a pulley in the lower part of the car and leaves through a passage between the pant-leg chutes. The chutes feed the coal into the bunkers through closure flaps or zippered rubber covers that seal the openings to reduce dust pollution of the bunker room.

A shuttle belt, Fig. 11, travels back and forth over the length of the bunker. It is reversible and discharges coal from one end or the other as desired to fill the bunker.

Belt conveyors on some recent installations have capacities of 2500 tons per hour. Conventional belt speeds are in the range of 600 fpm; however, European practice uses much higher speeds and this trend is being promoted here. Carrying idlers for use on coal have normally been set at a 20-deg angle to trough the belt. Development of lighter, stronger, more flexible belting has resulted in the promotion of 45-deg troughing idlers and reportedly will increase a belt conveyor's capacity by 50 per cent.

Some coal companies are drying wet screenings and slurry solids for sale for steam generating purposes. This type of coal is very difficult to handle and burn if it is not dried and protected from picking up moisture in transit or storage. Considerable savings are possible through use of these low-grade coals, but additional drying equipment may be necessary at the plant to avoid trouble in handling and burning. In the case of pipeline transport of coal in slurry form, driers are a necessary part of the firing system. END

Fig. 10. This belt tripper car raises belt off the conveyor

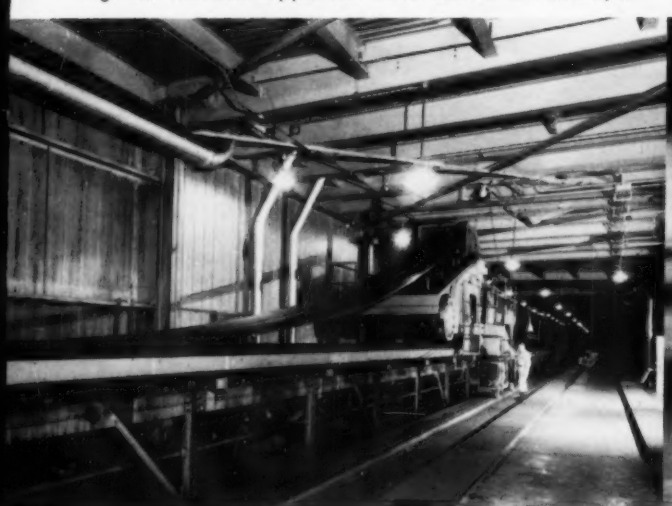
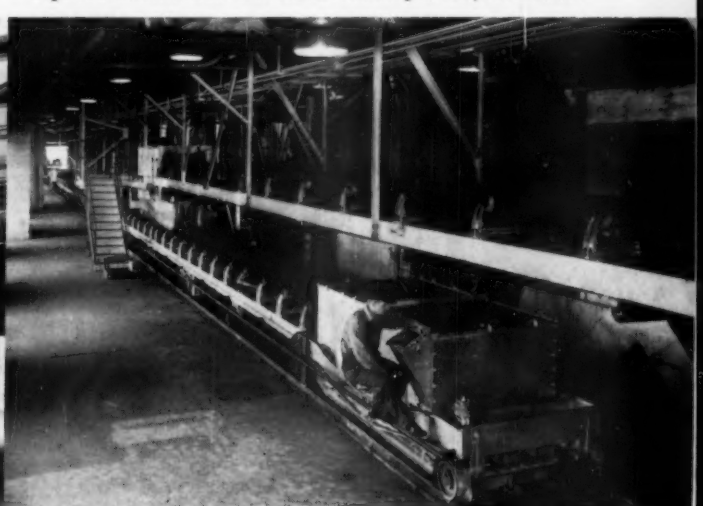


Fig. 11. Shuttle belt distributor running on top of bunker



ELECTRIC POWER FOR WORLD'S LARGEST MOBILE MACHINES

Giant strip-mining shovel will begin operation next year, and will use heavy electric power

THE FIRST Bucyrus-Erie 3850-B stripping shovel, the world's largest mobile machine, will start digging for coal in a Peabody Coal Co. open-cut mine next year. The electric-powered earthmoving giant is one of a pair of 3850-B shovels now taking shape at the Bucyrus-Erie Company's South Milwaukee (Wis.) works.

Peabody's present strip-mining equipment includes some of the largest shovels in existence, but the two new 3850-B's, each with a dipper capacity of 115 cubic yards and a working reach of 464 feet, will dwarf all present-day stripping shovels.

The evolution of larger strip-mining equipment had been a gradual trend for many years as mine operators sought economical means of handling millions of cubic yards of overburden covering even deeper coal seams. Largest stripping shovels in the field today are in the 55- to 70-cubic-yard-capacity class.

But the announcement of the first 3850-B shovel last year represented a major breakthrough in strip-mining equipment. It will enable miners to uncover deep coal which cannot be economically mined by the open-cut method with existing equipment. Sale of the first 3850-B was announced by Peabody Coal Co. and Bucyrus-Erie Co. in March 1960. Delivery of components to the mine is scheduled to begin this September. About 250 railroad cars will be used to ship the machine's parts, and erection at the mine is expected to take six or seven months or about 60,000 man-hours. The machine is to be erected during the winter and spring months and start digging in the fall of 1962.

Peabody's purchase of a second 3850-B was announced in April, and parts shipments for this machine will begin next year. Both mammoth machines will work in Peabody mines in the western Kentucky coal fields.

The new stripper will be under control of one operator who will guide the 7500-ton giant through its digging cycles with two hand levers and two foot pedals. The 3850-B will dig overburden in 173-ton bites, dump the material as far as 464 feet away, and swing back for another bite—all in 50 seconds. The machine will move some 36 million yards of overburden annually and uncover about 28 million pounds of coal a day. The operator will be stationed in an air-conditioned cab five stories above the pit floor. A passenger elevator will transport him to the cab.

COMPARING THE 3850-B to Peabody's River Queen stripping shovel, a Bucyrus-Erie model 1650-B, reveals the advanced capabilities of the new shovel. The 3850-B will stand 213 feet high, 73 feet higher than the River Queen. Its working weight will be almost three times the 2400-ton weight of the River Queen. Its boom will be 65 feet longer, its dipper handle 51 feet longer, and its working reach 169 feet greater. Dipper capacity of the 3850-B will be more than twice the 55-cubic-yard capacity of the River Queen.

Horsepower developed by the main power units of the 3850-B will be approximately 3½ times that provided by comparable motors in the 1650-B. The River Queen's hoist drums are powered by four 375-hp motors; the 3850-B will draw hoist power from eight 625-hp motors. Two 187½-hp motors power the River Queen's crowd; two 500-hp motors will handle the crowd function of the 3850-B. Swing power for the River Queen is delivered by four 187½-hp motors. The 3850-B's swing will be powered by six 500-hp motors.

Speed of the 3850-B's load dipper during its swing will reach 25 miles an hour. It will accelerate to top speed in eight seconds with a full load, and decelerate from 25 to 0 mph in four seconds on its return to the bank.

The two motor-generator sets in the 1650-B are rated at 1500 hp each, for a total of 3000 hp. The 3850-B will be equipped with four M-G sets, each of which will be turned by a 3000-hp motor.

MORE THAN 90 electric motors, ranging in size from ½-hp to 3000 hp, will power the new super-shovel; and additional current will operate lighting and heating equipment. A half million cubic feet of air per minute will be required for motor cooling.

Each 3850-B will move about on four pairs of crawlers. Each of the eight crawler treads will be made up of 37 pads, with each pad weighing 3700 pounds—or more than one million pounds of crawler pads alone. Propel power will be provided by eight 250-hp motors.

The machine will be automatically and continually leveled on its crawlers by four hydraulic jacks with pumps driven by four motors totaling 202 hp. Four more motors of the same sizes will activate the steering pumps. Four thousand gallons of fluid will circulate in the hydraulic system.

Two 50-hp motors will drive air compressors; 14 motors will drive lubricating oil pumps; 16 motors will drive blowers; and 28 motors will turn ventilating fans.

Other assorted electric-powered functions call for two 5-hp motors to pay out the big shovel's main cable, three 7½-hp motors for winch power, two ½-hp motors for the gang plank hoist, a 7½-hp motor for an overhead crane, and another 7½-hp motor to power the passenger elevator.

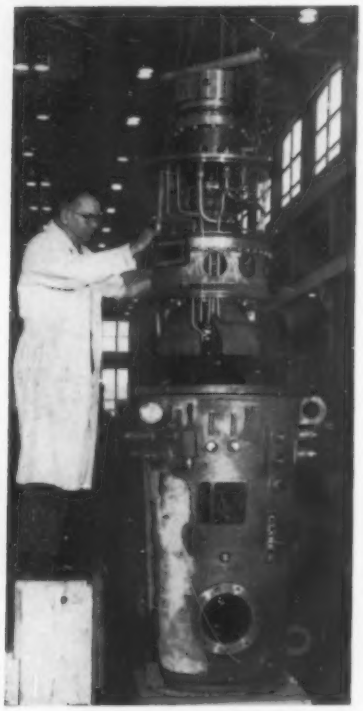
3850-B STRIPPING SHOVEL

	HORSEPOWER
4 M-G Sets — each	
1 3000-hp, 6600-volt synchronous motor	12,000
2 560-kw, 250-volt generators	
2 450-kw, 250-volt generators	
Exciter Set	
1 250-hp, 440-volt induction motor	250
2 65-kw, 250-volt generators	
1 50-kw, 125-volt generator	
Control Exciter	
1 50-hp, 440-volt induction motor	50
3 25-kw, 250-volt generators	
Hoist blowers—8 @ 7.5 HP	60
Swing blowers—6 @ 5 HP	30
Crowd blowers—2 @ 5 HP	10

	HORSEPOWER
Air compressor—2 @ 50 HP	100
Ventilating fans—8 @ 1.5 HP	12
20 @ 7.5 HP	150
Lubricating oil pumps—8 @ .5 HP	4
6 @ 1 HP	6
Propel motors—8 @ 250 HP	2,000
Leveling pumps—2 @ 100 HP	200
2 @ 1 HP	2
Steering pumps—2 @ 100 HP	200
2 @ 1 HP	2
Cable reel—2 @ 5 HP	10
Winch motors—3 @ 7.5 HP	22.5
Gang plank hoist—2 @ 0.5 HP	1
Overhead crane	7.5
Passenger elevator	7.5
TOTAL CONNECTED HP	**15,124.5**

NOW—A MOBILE NUCLEAR POWER PLANT

ML-1 is designed to operate 10,000 hours without refueling or overhaul



Closed-cycle gas turbine by Clark Bros. is designed for use in a mobile nuclear power generating plant

NEW TURBINE-COMPRESSOR scheduled for use in the world's first mobile nuclear-electric power plant has reached the testing stage. The turbine has been over a year in development by Clark Bros. Co. of Dresser Industries. It will be incorporated into a compact, power conversion skid which may then be operated in conjunction with the Army ML-1 portable reactor skid, as a closed-cycle, gas-cooled reactor turbogenerating system.

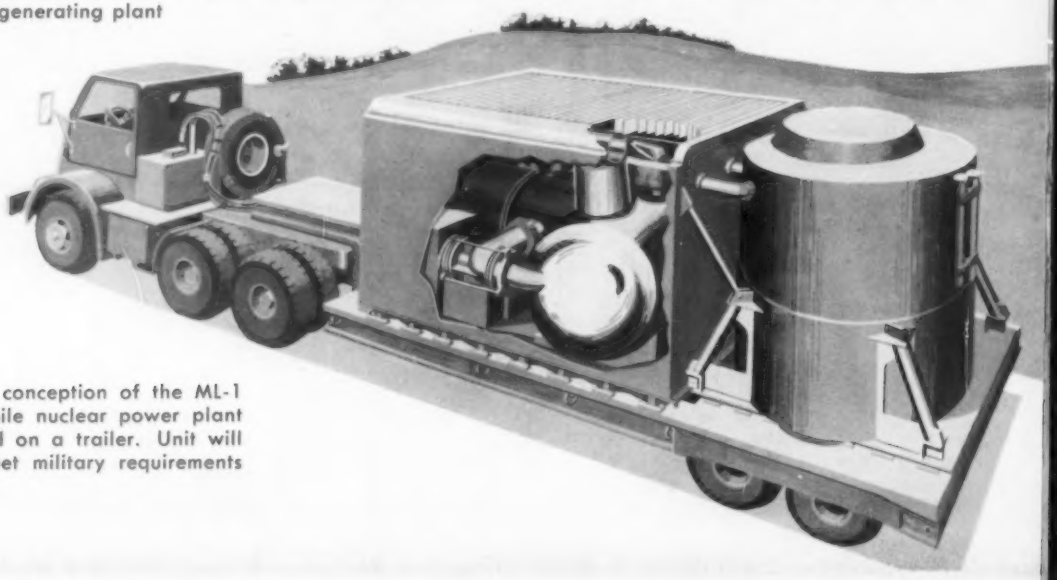
Aerojet General Corp. is developing the ML-1 for the department of Defense under contracts with the U.S. Army Corps of Engineers and the U.S. Atomic Energy Commission.

Designed to generate 330 kw, this prototype power plant will be capable of transport by truck, air, rail, barge or sled. It will be operational in any climate, any location, and will deliver rated output at ambient temperatures from 100 F to —65 F. The ML-1 is designed to be set up in 12 hours and to be relocated in 24 hours after shutdown.

Concept of a mobile nuclear power plant involves the use of nitrogen in a pressurized closed-cycle system. Nitrogen is introduced to the compressor at approximately 8 atmospheres, compressed to 20 atmospheres, passed through a recuperator where it picks up heat from the turbine exhaust and finally through the nuclear reactor, which raises the temperature to 1200 F. As the hot nitrogen expands in the turbine, it provides energy to drive the compressor and the generator.

Use of a recuperator increases over-all plant efficiency, reduces heat transfer requirements and size of both reactor and pre-cooler. Nitrogen is used as the ML-1 coolant because of its low activation and excellent thermodynamic properties.

The turbine is a single-shaft, axial-flow type built to operate at 22,000 rpm. It is similar to conventional axial flow units but is designed to weigh less than a ton. Light metals are used for static parts not subjected to severe temperatures. The compressor is also a high efficiency, axial-flow type. Although designed for pressurized nitrogen, the turbine compressor set can operate with air under emergencies. END



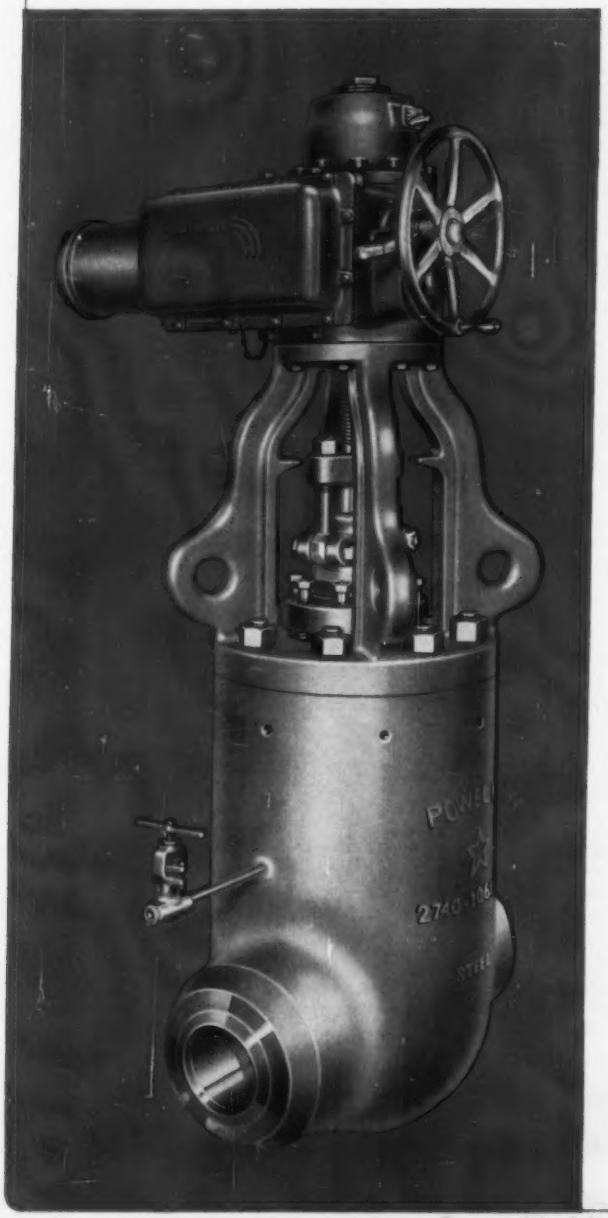
Artist's conception of the ML-1 mobile nuclear power plant mounted on a trailer. Unit will meet military requirements

EXTRA POWELL VALVE NEWS

THE WM. POWELL COMPANY CINCINNATI 22, OHIO

115th year of manufacturing industrial valves for the free world

NEW HIGH PRESSURE–HIGH TEMPERATURE VALVE FOR POWER PLANT OPERATION



AT 2740 psig AND 1060° F

Powell proudly presents this new Pressure Seal O.S. & Y. Gate Valve, especially engineered for ultra high pressure-high temperature service in one of the nation's largest modern plants. Its outstanding performance results from many key design features, such as:

- Body, Bonnet and Wedge of Chromium-Molybdeum Steel, according to ASTM specification A-217, Grade WC9.
- Internal working parts constructed of long-wearing materials, proven for uninterrupted service under severe operating conditions. Stellite facings on the wedge and seat rings.
- A Chrome-moly Bleed-off Valve extends through the body and facilitates valve opening by relieving pressure within the valve when it is closed.
- The top mounted weatherproof Electric Motor Operator, for remote control, has a *Spring* that automatically compensates for the changes of contraction or expansion of the valve stem, wedge and body. Proper and precise seating at all times is assured.

Development of this new high pressure-high temperature gate valve is positive evidence of Powell's ability to meet any industrial valve requirement—with regular or special designs—in bronze, iron, steel or alloys—for water, oil, gas, steam, and corrosive service. For further information or assistance, consult your nearby Powell Valve Distributor, or write direct.

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TRANSMISSION AND DISTRIBUTION GROUP MEETS IN CINCINNATI

THE T. AND D. COMMITTEE of the Edison Electric Institute recently held its 85th meeting in Cincinnati. This session was under the general chairmanship of Harold Cody, of Cleveland Elec. Ill. Co., and was attended by nearly 200 members and guests.

After a hearty welcome by S. M. Hamill, V.P. of Cinn. Gas and Elec. Co., the general sessions were first steered by Harold McNutt, Chairman of the General Engineering subcommittee.

First on the agenda was a paper by H. L. Collins (Penn. Power and Light) on the subect of Service and Facility Performance—Records and Analysis. He described his company's technique in gathering and analyzing data concerning interruptions in service. This is a very comprehensive procedure, said Mr. Collins; however, the work has not progressed to the state where definite action can be taken from the data accumulated.

Discussing the same subject of Service Reliability, H. Mac Vaugh (Phil. Elec. Co.) and Vic Bernthal (Comm. Edison) pointed out difficulties of using outage data after it has been accumulated. Reference was made to inadequate tree clearance in a discussion by Tom Hunter (Duquesne Light Co.). He stressed the fact that trees account for a large percentage of outages; also, that tree-trimming can be satisfactorily *work-measured.*

Zane Todd (Indianapolis P. and L.) gave an excellent talk on Calculation of Outage Frequencies in T. and D. Systems. He very effectively took out a lot of mathematical mystery in such calculations, reducing the process to fairly simple arithmetic.

NEXT on the agenda, the Underground subcommittee presented six very interesting papers on construction and operation of underground facilities. J. F. Hennessy steered this session.

M. R. Mosquini (So. Calif. Edison) gave an excellent talk on Precast Concrete Vaults, which showed most satisfactory experience in his company's operations. (These vaults are of lightweight concrete and can be installed quickly, thus effecting considerable cost savings.)

Describing some of the problems in operating an unusual underground system, W. J. Montgomery (Cinn. Gas and Electric) explained how his company maintains equipment under severe conditions, such as flooded vaults.

Next, Howard Davis (Phil. Elec. Co.) commented on the 1959 Underground Cable Performance Report. This report, said Davis, presents the experience of 16 companies, and covers some 20,000 miles of cable, 419,000 joints and 76,000 terminations. This report shows an increasing number of faults in cable and joints, but a slight decrease in terminations.

R. M. Lewis (Boston Edison) described his company's very elaborate system used in scheduling engineering and construction work loads. His conclusion was that such careful planning pays big dividends in *construction*—as it does in *maintenance.*

"Is Buried Cable the Answer for Residential Underground?" was the subject of a good paper by C. R. Machen (Pacific G. & E.). He described his company's experience in this field, and concluded that they are now placing all such cables in the *front* of property—in parkways. (Their experience in rear-property installations had been very unsatisfactory.)

R. H. Kolks next reported on Cincinnati's Cable Movement Investigation. (This was a progress report on work done to date.)

THE SECOND DAY. Opening the second day's session, Prof. Edmund Ayres, of Ohio State University, gave a fine talk on the theme of how to entice engineering graduates into the "less-glamorous" side of power engineering. According to Prof. Ayres, utilities must do two things: (1) Capitalize on the glamour that exists in the utility field; and (2) offer the young engineers an immediate challenge—to make their jobs more interesting.

J. Lummis was chairman of the Overhead subcommittee's portion of the session. His group presented some very excellent material in the form of papers on conductors, hotline work, connectors, towers and safety.

Maximum Thermal Capacity of Transmission Lines was discussed by C. H. Schofer (Penn. Power and Light). This paper presented some very enlightening results of a study made to determine optimum current-carrying capacity of conductors. This study involved both temperature and conductor-tensile-strength conditions, resulting in conclusions which permit most economical design of transmission lines.

Giving the audience a full-scale presentation on Bare-Hands Hot Line, H. L. Rorden (A.E.P.) and Dr. C. J. Miller (Ohio Brass) told of the development of this technique and presented actual photo slides of maintenance on hot lines. The system has been accepted as standard practice by crews in Amer. Elec. Power, and predictions are that all companies will find it very practical in their maintenance operations.

Speaking on Connector Reliability, Mike Mosquini (So. Calif. Edison) discussed his company's investigations into line failures due to this type of hardware. His conclusions: There's nothing wrong with present-day connectors; the faults lie in their installation.

ALUMINUM TRANSMISSION TOWERS came into the limelight in a good presentation by John Maples, of Reynolds Metals Co. He told of the research and development work being done by Reynolds at their Phoenix, Arizona plant. His remarks proved that aluminum towers, with new design and lower-cost erection, are fast finding their rightful place in the transmission field.

In the field of Safety, J. J. Misic (Cleve. Elec. Ill. Co.) and L. J. Renas (Dayton Power and Light) gave good talks on "Heart Massage" resuscitation and 12-kv hot-line work, using rubber gloves. Both talks offered much to investigate.

Following these talks, various members of the Standards and Specifications subcommittee task forces reported on the status of their investigations in hardware, tools, timber products and cables.

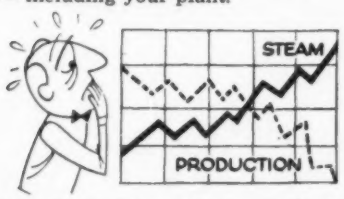
In general, this was a most successful meeting, and clearly demonstrated the intense interest in transmission and distribution developments. END

ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

SARCO TOPICS

STEAM CONSUMPTION WAS ERRATIC AT THE SHERATON-ATLANTIC

This is a documented steam story, and if you have the *least* interest in reduction of steam costs you'll read on. The events took place in the laundry and dry cleaning department of the Sheraton-Atlantic Hotel in New York, which purchases district steam; but they could have happened in *any* steam using establishment — including your plant.



This documentary is concerned with money — (their steam bills for laundry and dry-cleaning were tremendous) and how the Sheraton cut the bill $8500 in one year. That's giving away the climax, but not the plot. To begin with, the Sheraton engineering department kept a daily log which revealed excessive steam costs and startling discrepancies. For example, on one day, 44,000 lbs. of district steam were metered and 20,300 pieces finished. On another day, 38,000 lbs. of steam were metered and 23,300 pieces finished. Clue: This ratio was obviously cockeyed!

To relieve your suspense, we can tell you that the Sheraton removed competitive bucket traps and installed around fifty Sarco Thermo-Dynamic Steam Traps, Type TD-50, on the discharge side of each piece of steam heated equipment, and on drips on supply mains between meters and equipment, as recommended by Sarco. The results were dramatic. (Strong men didn't weep, but they did clap their hands a bit.) In the pre-Sarco December, 868,000 lbs. of steam were purchased for $1725. In the post-Sarco December, only 532,000 lbs. of steam were purchased, for $1025. And the volume of work had increased!

There are no crystal gazers on the Sarco staff; lots of competent engineers, though. These steam detectives find inefficient steam trapping at the bottom of countless high cost mysteries. Sad part of it is, the high cost of steam is only part of the story. Inefficiency in trapping can create other costly problems, too.

We talk a lot about our Thermo-Dynamic trap, don't we? So do other people. In fact we're quite used to grateful cheers of appreciation. Why don't you get the full story, by asking for it? Phone, telegraph, mail—choose your favorite medium of communication.

SARCOTROL! OUR WORD FOR SOMETHING SPECIAL IN TEMPERATURE CONTROL

It may be just what you've been looking for. We don't know. It's rather unusual. We know what it can *do*, but we still don't know everyone who needs it, even though we've been selling Sarcotrol successfully for many years to the plastic fabricating industry. New people we never heard of keep popping up saying it's just what they've needed.

When we designed Sarcotrol we planned it for specific use as a heating and cooling unit for injection molds, cylinders, rolls and drums. What surprises us is that so many different kinds of other equipment are evidently now in search of just such a control, from Banbury mixers to electric coffee pot testers.

The Sarcotrol is a portable, automatic temperature control system utilizing closed recirculation of the heat transfer fluid, to insure even temperatures throughout the equipment being heated and/or cooled. Here's the operating principle. Btu's are supplied to or removed from the rapidly moving high-pressure, high temperature fluid; the variations between delivery and return temperatures being held to a very narrow segment of the Sarcotrol's wide temperature adjustment range. A broad range of flow rates is available to handle widely varying heating and cooling loads, while maintaining tight control of temperatures across the equipment. The basic control mechanism is our own electric indicating controller. Four

standard, fully adjustable, working temperature ranges, cover all heating or cooling requirements between 0° and 300°F. (Keep reading . . . you can always go back for details.) On start-up, full heater capacity is available, and when circulating water approaches control point, heat input is automatically reduced for closer control. Temperature control instruments are automatically compensated for ambient temperature variations.

Heard enough? If not, you must feel a responsive chord vibrating, so write for details. There's literature available which contains much more information than we can give you in this chat.

OUR NEW PUBLICATION IS PRACTICAL—PLUS

SARCOSCOPE is our new house magazine into which we pour what we hope will be a useful mixture of ideas, case histories, tips, facts, news, and sense — both common and uncommon. If you are not receiving

it, we'll be happy to send future issues to you. Just send your name and address. Sarco publishes it as a service to people interested in the conservation and control of heat. We try to keep it down-to-earth, practical and useful.

SO YOU THINK YOUR PROBLEM'S UNIQUE?

Lots of hot water and steam is being wasted these days, in lots of ways. If your eyes glaze as you watch your steam bills mount or shut down your equipment for maintenance, you probably wonder what you did to deserve such problems. If it's any consolation, it's very unlikely that you are alone in your misery. The chances are excellent we have solved just such a problem already for plants similar to yours. Try us. Describe your problem in a letter. We'll probably be able to send you a set of Sarco Case Histories, describing how other plants were able to conquer problems like yours.

5897

SARCO

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PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES

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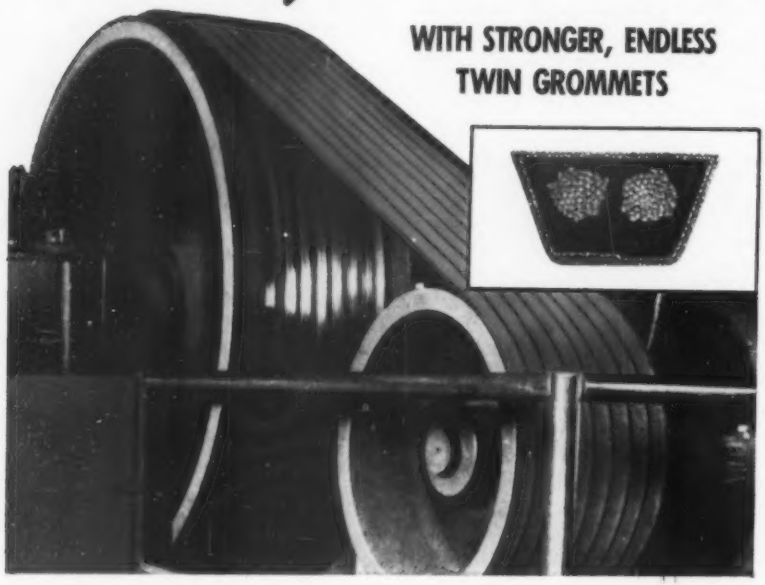
GOODALL

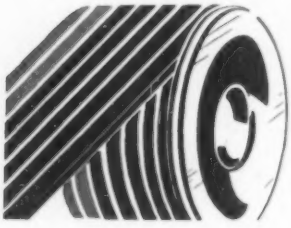
"PowerKing" VEE-BELTS

WITH STRONGER, ENDLESS TWIN GROMMETS



Try "Power-King" Vee-Belts—and note the savings they give through increased load-pulling capacity and efficiency.

The larger, stronger, continuous twin grommets permit the use of greater horsepower on the drive. Stretching is reduced—tension sustained. Belts last 20% to 50% longer.



FEWER BELTS PER DRIVE

Because each "Power-King" Vee-Belt exerts one-third more *gripping* power —more *driving* power—than an ordinary belt, *fewer* belts are required for any given load. Pulleys can be narrower, over-all weight less.

"If it's GOODALL, it MUST be Good!"

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Around the power circuit

Continued from page 6

cost techniques to attain optimum fuel density. These balls may then be loaded and unloaded from a reactor like tennis balls.

Reprocessing of fuel particles may be accomplished by a simple crushing and gravity separation process at the end of the fuel's useful life. This indicates a considerable saving over chemical reprocessing costs of metal clad fuel elements.

THE 1961 Industrial Professional Development Award of the National Society of Professional Engineers will be presented to the instrument and transformer centers of the General Electric Co., at the Society's annual meeting in Seattle, July 7.

Another GE honor: Workers at the safety-minded Hanford Atomic Products Operation plant have received the National Safety Council's Award of Honor for completing more than a year's work without a lost-time accident.

NORTHWESTERN UNIVERSITY's Gas Dynamics Laboratory faculty is being increased by five men; space for laboratories and offices in Northwestern's Technological Institute is being more than doubled; and plans call for sharply boosting the number of graduate students from the present 24.

Formerly a part of the mechanical engineering department, the Gas Dynamics Laboratory now becomes an independent interdisciplinary laboratory open to faculty and students from engineering and science.

STONE & WEBSTER engineers have developed a new and cheaper way to anchor electric transmission towers in slack soil. Research included use of an electronic computer program tailored to the specific soil conditions at Project EHV. S & W found that a single vertical pile under each tower leg, when linked to the others by a four-cornered steel frame, would provide sturdy underpinning in soils requiring driven piles. *Cont'd on page 78*

Power plant stretches diesel service -cuts maintenance costs- with

By C. F. KLENNER Carl Klenner is a specialist at helping customers with their lubrication problems. A graduate of the Michigan College of Mining and Technology, he has been serving commercial customers since 1948. He also attended the Company's Sales Engineering School.

★ ★ ★

At Roseau, Minnesota, the Municipal Power Plant uses Fairbanks Morse Diesel Engines for the generation of the city's electricity. And since 1946, lubricating oils supplied by our Company have played an important part in the excellent maintenance of this plant.

For example, diesel unit number two was overhauled in 1954 after six years' service. At our recommendation, AMERICAN D&G Oil No. 53 was put in the crankcase at that time. After 19,000 hours of oil service, the unit was taken down again. All rings were free, bearings and rings showed minimum wear, and there was negligible carbon on the piston skirts. With AMERICAN D&G Oil, this unit has averaged 4,584 horsepower-hours per gallon of oil.

For additional information about AMERICAN D&G Oil, contact your nearby American Oil Office.

American's C. F. Klenner checks performance reports with power plant superintendent Carl Grand.

Quick facts about
AMERICAN D&G Oil

- Made from highest quality solvent-refined stock.
- Contains additives which impart superior detergent-dispersant and anti-corrosion properties.
- Anti-foaming.
- Oxidation resistant.
- Recommended for
  —use with economy fuels.
  —extreme load service.
  —low temperature service.

AMERICAN OIL COMPANY
910 S. Michigan Ave., Chicago 80, Ill.

AMERICAN

AMERICAN® D&G Oil No. 53

Here's POWER to clean tubes from 1/2" to 2" QUICKLY

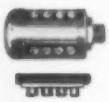
Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

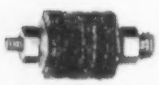
Simplicity of Rotojet design and precision construction assure long service, efficient use of power, and freedom from trouble. Economical brushes, cutters, and scrapers meet practically any requirement.

Send for Bulletin J-410.

Expanding scraper and replaceable element.



Expanding brush and replaceable element.



Sectional wire brush.

Air valve for one-man operation.

ROTOJET® Junior TUBE CLEANERS

ELLIOTT COMPANY – ROTO PLANT

Tube Cleaner Specialists Since 1910

1071-47 Bristol Road, Mountainside, N.J.

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The company's engineers are now employing the new method in supporting 35 transmission towers for the Savannah Electric and Power Co. along a 10-mile project north of Savannah, Ga. Savings traced to the new technique are estimated at $1000 per tower.

SHERMAN R. KNAPP, president of Edison Electric Institute and of Connecticut Light & Power Co., sent a letter to Representative Chet Holifield, chairman of the U.S. Congressional Joint Committee on Atomic Energy, in which he stated the position of EEI with regard to the addition of generating facilities to the New Production Reactor (NPR) at Hanford, Washington.

In the light of testimony offered at the May 17 hearing on the NPR, Rep. Holifield questioned the accuracy of the letter. Mr. Knapp then wrote a second letter in which he reiterated these main points.

1. Addition of generating facilities to NPR at a cost of $95 million will not make a contribution to nuclear power technology. Nuclear power technology could be advanced better by sponsoring more basic research and development programs.

2. It is not a proper function of the Federal government to build and operate thermal plants for producing power for sale to the public.

3. As electric power capacity can be financed in the free market, there is no need for government spending for this purpose.

Since the transcript of the May 17 hearing apparently contained no reference to points 2 or 3, Mr. Knapp assumed that the question of accuracy referred to Hanford's possible contribution to nuclear power technology. This point he again emphasized, stating that economically competitive nuclear power certainly will not be achieved if we must rely on the steam conditions of the NPR.

GENERAL ELECTRIC has operated the full, 4½-mile length of their prototype transmission system, Project EHV, at 770,000 volts. This voltage was applied briefly to test the insulators, conductors and 18 different transmission towers at the project. Continuous operation along the entire, open-ended line is now under way at 500 kv.

new engineering books

High-Voltage Direct-Current Power Transmission, by Colin Adamson and N. G. Hingorani; 300 pages, illustrated, size 7½ by 10 in., cloth binding. Published by Garraway Limited, 11 Kensington Church St, London W. 8, England. Price $14.

This is an important contribution to the literature of electric power transmission.

High-voltage direct-current transmission lines are actually in operation in Europe and Russia. These include both overhead and submarine lines. Other such lines are being planned for various parts of the world. Central Electricity Generating Board in England is setting up a major testing station for full-scale d-c transmission experiments.

The authors of this book approach the subject from the English point of view, of course. They are both connected with the Power Systems Laboratory of the Manchester College of Science and Technology in Manchester, England. Dr. Adamson, in particular, is well known in Europe as an authority on power systems design and operation, and is an expert in the field of static relaying.

The book begins with a discussion of the general considerations of a-c and d-c systems, pointing out the advantages and a few disadvantages of high-voltage d-c transmission. The next chapter discusses the use of converter circuits and rectifier connections for various conditions. There are chapters on details of inverters, requirements for grid control of the mercury-arc rectifiers, compounding and regulation. Another chapter discusses protection of high-voltage, direct-current systems, and another deals with reactive power requirements and how they must be supplied. Artificial commutation is described in detail. Another chapter discusses use of earth return or sea return. Still others discuss harmonics, insulators, corona. Much detail is given in a chapter on high-voltage, heavy-current, mercury-arc rectifiers; and there is a final chapter on direct-current cables.

This book is for those who are fairly well-grounded in both electric transmission theory and practice.

Another Reason You're Money Ahead With

Verti-Line Pumps

LARGER-Than-Standard Shafting Minimizes "TWIST-OFFS", LENGTHENS PUMP LIFE!

When you specify Layne & Bowler "Verti-Line" Pumps you are buying pumps built to standards far beyond those used for conventional vertical turbine pumps. For example, in "Verti-Line" Pumps tougher, longer-lived "Moly" Iron is standard construction *at no extra cost.* The unique Perihedral 2-Way Pump Seal is another extra-performance feature built into every "Verti-Line" Pump. And still another is the much heavier pump shafting used in all "Verti-Line" Pumps...

The Pump Shaft in a vertical turbine pump is one of those critical parts you can't see—but its size and construction mean a lot in the performance you get. The pump shafts in "Verti-Line" Pumps are not only made of carefully-selected alloy steel—the best available for the purpose—but are also considerably larger in cross section than are the shafts used in most other pumps.

Larger pump shafting means larger bearing surfaces, a steadier-running pump, and much less risk of "twist-offs" or maintenance problems when sudden loads are placed on the impellers—or when the impellers strike debris in the fluid being pumped. This is one more of the many hidden "extras" you get when you specify Layne & Bowler "Verti-Line" Pumps—the pumps that are built *up* to performance, not down to competition. Yet you pay no more for the extra values built into "Verti-Line" Pumps. In fact, you actually pay *less* because of the longer life and lower maintenance these quality pumps provide!

"Verti-Line" Pumps are available in a complete range of sizes... 20 to 10,000 GPM—1½ to 1000 H.P.—Heads to 650 ft.

Send for "Verti-Line" Bulletin #1100 that gives helpful details on these advanced vertical turbine pumps!

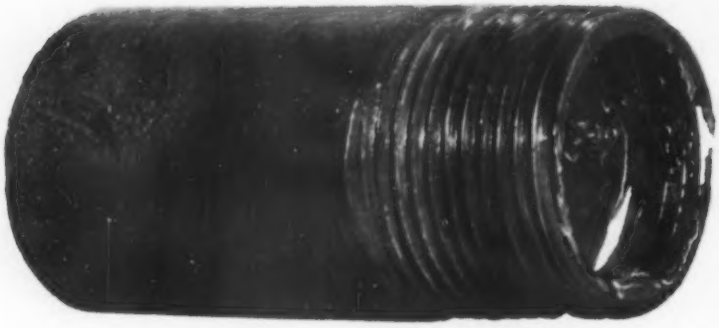
Verti-Line Pumps are the exclusive products of

LAYNE & BOWLER PUMP COMPANY
LOS ANGELES 22

New York 20, N.Y. • Chicago 4, Ill. • Hastings, Neb. • Monroe, La.
Farwell, Texas • Twin Falls, Idaho • Fresno, Calif.

For more data circle 533 on Post Card

RETURN LINE CORROSION MUST BE STOPPED!



Unheeded build-up of corrosion products and corrosion can shorten return condensate pipe life by years . . . multiply maintenance and replacement costs drastically.

Bird-Archer Amine Treatments, both filming and neutralizing, check severe return line corrosion easily, effectively, and economically. After two years of Amine Treatment, a Massachusetts power plant making over 250,000 lb. of steam per day, enthusiastically reports a 75% reduction in piping replacements with the use of only 2 or 3 lb. of Amine Treatment daily.

Return line corrosion *must* be stopped, and *can* be stopped. Write for Bulletin CP100 and the name of the Bird-Archer Service Engineer nearest you.

BA101

BIRD-ARCHER

WATER TREATING CONSULTANTS

The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa. / New York • Chicago

The BIRD-ARCHER CO. of California, 415 Brannan St., San Francisco • Offices in Canada and Mexico

For more data circle 560 on Post Card

new power construction

Ketchikan, Alaska—Municipal Power & Light Department of the City of Ketchikan has announced a major expansion and improvement program of Whitman Dam, including its rehabilitation, replacing penstock, powerhouse and transmission lines. Work will go ahead early in 1962 at an estimated cost of about $1,300,000.

Healdsburg, Calif. — Pacific Gas & Electric Co., 245 Market St., San Francisco, has authorized plans for major plant expansion at its Geysers Geothermal Power Plant located here. Plans call for installation of a second 12,500-kw generating unit which will use live steam from wells drilled in the earth as a power source. Work on the new unit will begin late this year for completion in about two years. Program will cost $2,200,000.

Upland, Calif. — Board of Trustees, San Antonio Community Hospital, 999 San Bernardino Road, this city, has authorized plans for a major expansion and improvement program of hospital facilities at this location. Work will include construction of a 3-story reinforced concrete building and power plant installation, shop additions, and remodeling and modernizing of existing buildings. Work will begin soon with completion scheduled for early 1963. Cost is reported to be over $3,000,000.

Joliet, Ill. — Commonwealth Edison Co., 72 W. Adams St., Chicago, Ill., has announced a contract award to the Westinghouse Electric Corp., Pittsburgh, Pa., in the amount of $10,000,000 for construction and installation of a 560,000-kw turbine-generator at Edison's Joliet Power Station located here. Equipment will be completed and ready for installation early in 1963.

Maquoketa, Iowa—Municipal Power & Light Department of the City of Maquoketa, City Hall, has authorized expansion of the municipal electric light and power plant, for increased capacity, with installation of a 2600-kw diesel engine generator and complete auxiliary equipment. Work will begin soon and is scheduled for completion by the spring of 1962. Cost of the installation is reported to be $525,675, with contract award going to Fairbanks Morse & Co., Omaha, Nebraska.

Clay Center, Kansas—The Municipal Light & Water Commission has authorized plans for a major expansion of the municipal power system in this city which will include the installation of a new turbine-generator, for increased capacity, along with high pressure boilers and auxiliary equipment.

Contract of $236,875 has been let to the General Electric Co., Kansas City, Mo., for the unit, and to the Wicks Boiler Co., Shell Building, Tulsa, Okla., for the boilers and installation in the amount of $117,103. Work on the expansion program will get under way at once and is scheduled for completion by the fall of 1962.

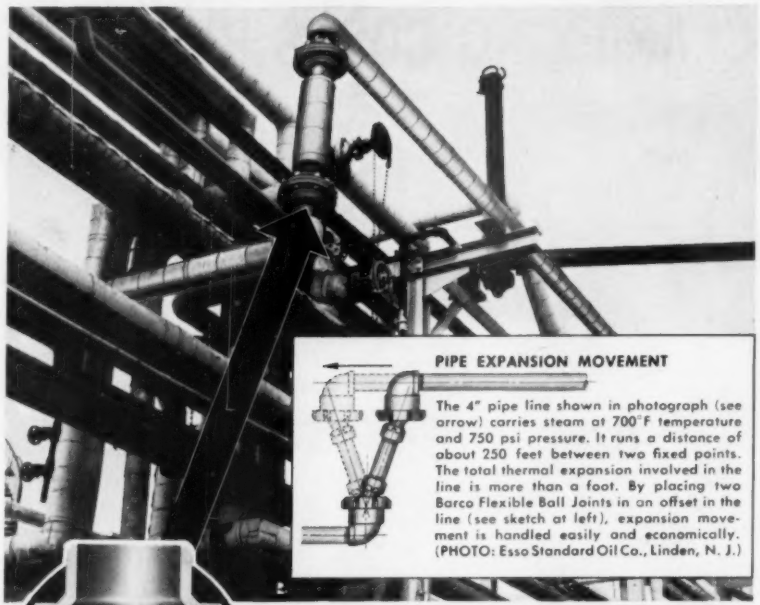
Harroldsburg, Ky.—Kentucky Utilities Co., 120 South Limestone St., Lexington, Ky., has approved plans for the installation of a new steam electric generating unit at its Dix Dam Station, located in this city. New installation will have an initial capacity of 156,250 kw and will cost approximately $17,500,000 when completed. Work will get under way at once.

Duluth, Minn.—Minnesota Power & Light Co., 30 W. Superior St., has proposed a joint venture with 10 Minnesota electric cooperatives under which the cooperatives would build a 100,000 to 150,000-kw generating plant with a Government loan, which in turn would be turned over to the Minnesota Power & Light Co. for operation. Proposed plant would be built in northern Minnesota. Nine of the 10 co-ops, none of which generate its own power, buy electricity from Minnesota Power & Light Co., but are considering the possibility of buying power from large plants proposed for North Dakota by groups of co-ops in that area. Minnesota's power plan would have advantages both for the co-ops and themselves, since power costs would be competitive with the North Dakota group.

Sherburn, Minn.—Interstate Power Co., 1000 Main St., Dubuque, Iowa, has announced a major expansion and improvement program of its Fox Lake Power Plant located here. Work on the superstructure is already under way and work will include installation of a steam electric generator with a capacity of 84,000 kw, new steam boilers and auxiliary equipment. Fuel Economy Engineering Co., New York Building, St. Paul, Minn., has been awarded a contract of $12,000,000 for the work.

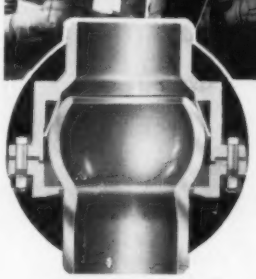
Hardin, Mont.—Bureau of Reclamation, Department of the Interior, has authorized a contract award of $39,809,359 for the construction of Yellowtail Dam, and Power Plant, 45 miles southwest of here, to Morrison-Knudsen, Inc., 319 Broadway Ave., Boise, Idaho. Work will include an arch-type concrete dam 520 ft high and approximately 1450 ft long; spillway; intake structure; power plant and outlet structures at the foot of dam, to accommodate four 50,000-kw generating units driven by 70,000-hp hydraulic turbines. Preliminary engineering work is already under way and will take more than four years to complete. Associated with Morrison-Knudsen, Inc., as joint participants on the project, are the Kaiser Company, Perini Corp.,

How Plant Handles 700°F. STEAM . . . PIPE EXPANSION



PIPE EXPANSION MOVEMENT

The 4" pipe line shown in photograph (see arrow) carries steam at 700°F temperature and 750 psi pressure. It runs a distance of about 250 feet between two fixed points. The total thermal expansion involved in the line is more than a foot. By placing two Barco Flexible Ball Joints in an offset in the line (see sketch at left), expansion movement is handled easily and economically. (PHOTO: Esso Standard Oil Co., Linden, N. J.)



BARCO HT HIGH TEMP. Flexible BALL JOINTS

SAVE VALUABLE SPACE

ADVANTAGES:

SAVE SPACE — Barco Ball Joints are used to perform functions similar to U-bends or pipe loops — But with much less space required and often LOWER COST.

NO PRESSURE THRUST —Expensive anchoring or bracing not required to hold piping in place or in line.

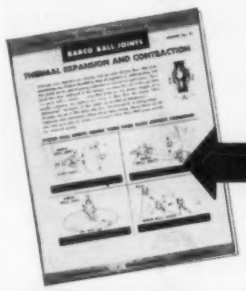
HIGH TEMPERATURE, PRESSURE — Wide choice of materials in new Barco HT Joints.

SIMPLE — Eliminates much tedious pipe stress analysis calculation.

The Barco HT (High Temperature) Flexible Ball Joint is a new development. It is *the key* to solving many PIPE EXPANSION PROBLEMS where high temperatures and pressures are encountered. HT joints can be supplied in sizes from 2" to 16", angle or straight, and can be fabricated from materials to withstand as much as 1000°F, 1200°F, or even 1400°F, under certain conditions.

Rugged "Fire-Safe" Barco joints have no thin wall sections, no critical points of fatigue, no rubber seals. They develop no "end thrust". . . *no reactive forces;* require no expensive anchoring. They are ideal for steam and all kinds of fluids.

Local Barco Field Engineers will be glad to give you full information and recommendations. Call or write today.



Send for this BULLETIN 31

"How To Use Barco Expansion Joints". Complete with piping layout drawings and illustrations. Shows how to cut costs, save time, and do a better job!

PRODUCTS BACKED BY EXPERIENCE BARCO FOUNDED 1903

BARCO MANUFACTURING CO.

547H Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Rotary Joints

In Canada: The Holden Co., Ltd., Montreal

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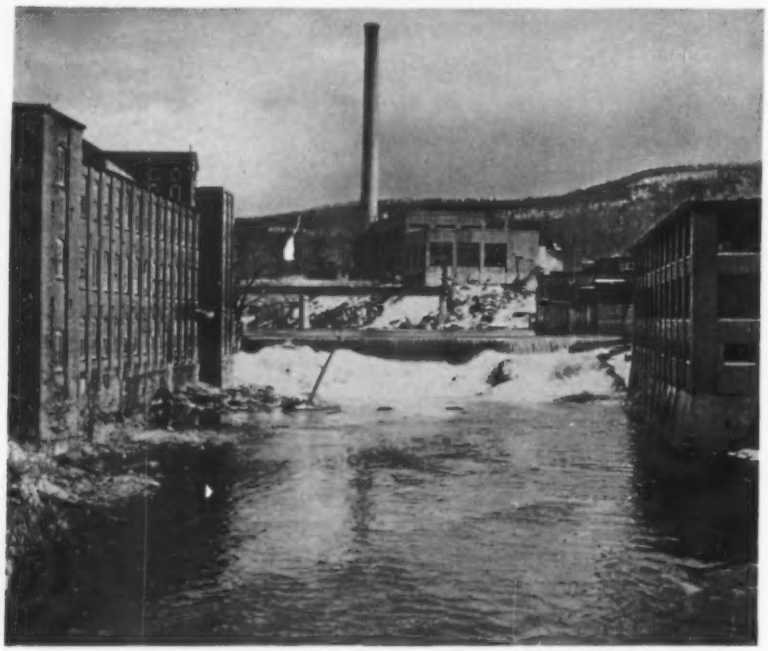
at Ware Industries...

HAGAN COAGULANT AID CUTS CLARIFYING COSTS BY 53%



Ware Industries, Ware, Massachusetts, owns and operates this complex of buildings, leasing them to several textile manufacturers.

Quick case history — reading time 68 seconds

THE PLANT: Ware Industries owns and operates a group of huge manufacturing buildings. Tenants are textile manufacturers, most of whom produce high quality, pastel colored woolens. Ware provides building maintenance and power, steam and process water.

THE PROBLEM: Ware River water carries some plant effluent and heavy run-off from fields and forests. Color averages from 50 to 60 ppm, but may run as high as 80 to 90 ppm. Due to the delicate woolen colors produced, maximum tolerable water color is 5 ppm. The plants use 1½ million gallons of water per day, and clarification with alum and caustic soda had produced acceptable water, but chemical costs were high.

THE SOLUTION: After several unsuccessful attempts to use a coagulant aid, Hagan Coagulant Aid No. 323 was tried. Because it produces a larger, tougher floc that settles fast, the Hagan Aid proved to be the solution to the problem. Hagan Aids are easy to feed, are non-toxic and are available in a range of formulations to suit most water conditions.

RESULTS: Results were spectacular. Alum use fell from 1400 pounds per day to 500 to 600 pounds per day. Use of caustic soda also dropped. Only two quarts of Hagan Coagulant Aid are used per day. Chemical costs have been cut by 53%, nearly $10,000 annually.

WANT MORE INFORMATION on the ability of Hagan Coagulant Aids to solve clarification problems? **Write or phone for Bulletin HSP-919.**

Hagan Aid is measured prior to mixing.

HAGAN
CHEMICALS & CONTROLS, INC.
HAGAN CENTER, PITTSBURGH 30, PA.

HAGAN DIVISIONS: CALGON CO. • HALL LABORATORIES • BRUNER CORP.

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Walsh Construction Company, and also the F & S Contracting Company.

Asbury Park, N. J.—Jersey Central Power & Light Co., 501 Grand Ave., this city, has authorized plans for a major expansion program through the 1960's to expand customer service to more than 400,000 customers by 1970. Company's proposed new generating station, in Lacey Township, in its first stage would have a capacity of 250,000 kw and will cost an estimated $50,000,000. Company is currently closing title to a large building site for the plant. Ultimate plans call for a capacity at this station of more than 1,000,000 kw, with a final cost of better than $200,000,000. Initial operation of the plant is scheduled for some time in 1965. Full operation is planned for early 1970.

Island Park, N. Y. — Long Island Lighting Co., 250 Old Country Rd., Mineola, N. Y., has plans under consideration for the construction of a second generating unit at its existing power station located here, bearing the name of E. F. Barret Power Station. Plans call for the installation of a new steam electric generating unit with a capacity of 185,000 kw, along with high-pressure boilers and auxiliary equipment. Construction of the new installation will not begin until early 1963 and will take between two and three years to complete. Cost will run between $30,000,000 and $40,000,000 when completed.

Painesville, O.—City Municipal Power & Light Company has approved plans for a new addition to the municipal power plant located here. Plans call for installation of a new generating unit with an initial capacity of 16,500 kw, and auxiliary equipment. To cost in excess of $1,000,000, work will begin soon.

Burns, Ore.—Harney Electric Cooperative, Box 263, this city, has authorized plans for the installation of 148.2 miles of new transmission lines for increased power distribution through parts of the State of Nevada, which it serves. Contract in the amount of $322,301 has been awarded to the Bonneville Construction Co., Idaho Falls, Idaho, for the work.

Knoxville, Tenn.—Tennessee Valley Authority, New Sprankles Building, this city, has authorized plans for the construction and installation of transmission lines and connections, including two 161,000-volt transmission lines each to Bowling Green and Hopkinsville, Ky., and Nashville, Tenn., and one 161,000-volt line to Clarksville, Tenn. Work is in connection with the construction of the Authority's Paradise Steam Plant, now under construction at Paradise, Ky. Work on the line installations will begin soon for completion in about two years. Cost is reportedly about $22,000,000.

Washington, D. C.—The Atomic Energy Commission, 1901 Constitution Ave., N.W., has announced termination of an agreement with two groups of utility companies to build an experimental 50,000-kw reactor in Polk County, because of technical and economic uncertainties. The Florida project was proposed two years ago by two utility combines.

So You're Buying a Water-Tube Package Boiler

Continued from page 58

shows that there are a number of points at which the "confusion" of the air flow regulator *must* exist. The problem was evidenced by heavy smoking as firing rate was increased until 40 per cent of rating was reached. At this point the air flow controller, not being satisfied by conditions at some lower firing rate, reacted so that proper firing conditions were established.

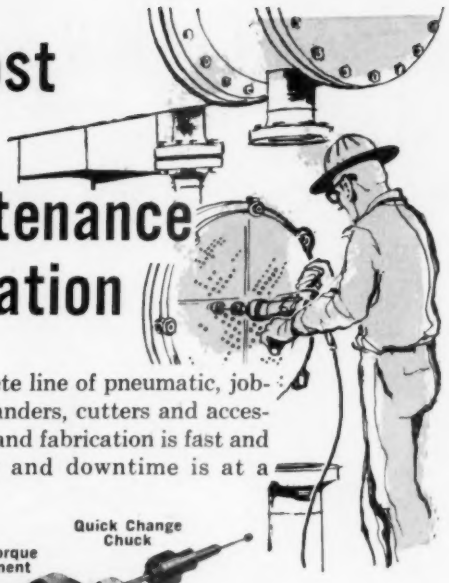
Solution: Forced-draft fan damper was limited to a closure equivalent to 40 per cent rating, and high excess air was accepted as fuel was turned further down to the desired firing rate. The point is, of course, that the extra investment for metering combustion was largely wasted, start-up time was excessive and a more efficient operation would have been possible with a simple parallel control system.

The above should not be construed as a rejection of metering or metering-type controls. It is rather an admonition to consider all the peculiarities of your installation when selecting a control system.

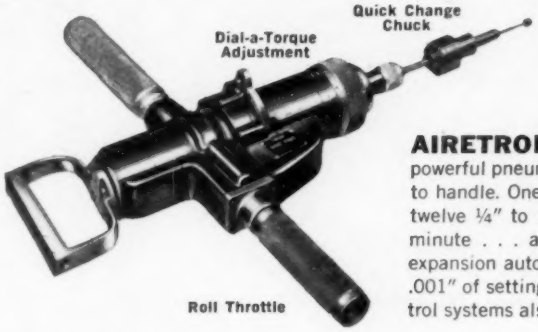
There are of course other trouble-producing areas of interest. I have discussed here one of the least obvious in order to emphasize how problems can pop up where they're least expected. Other sources of difficulty are frequently found in oil storage and supply systems, flame safeguard systems, fully automatic operation, feedwater arrangements, matching boiler capacity to plant load and combustion control systems —to name some of the most troublesome.

These points are raised not to frighten away the prospective package boiler buyer, but rather to help him appreciate the fact that some sound thinking and planning are essential in approaching the installation. By all means take advantage of the dollar savings available to do-it-yourself boiler purchasers; but to insure a successful installation, enlist some good engineering advisors and be sure to check with other do-it-yourselfers. END

get low-cost accurate tube maintenance and fabrication



. . . with Airetool's complete line of pneumatic, job-proven tube cleaners, expanders, cutters and accessories. Tube maintenance and fabrication is fast and accurate. Costs are low and downtime is at a minimum.



AIRETROL . . . compact, powerful pneumatic motor, easy to handle. One man rolls up to twelve ¼" to 1½" OD tubes a minute . . . accurately. Stops expansion automatically within .001" of setting. Electrical control systems also available.

CC-475 CONDENSER TUBE CLEANER . . . typical of Airetool's wide range of pneumatic geared and direct drive cleaners. Lightweight, less than 10 lbs., easy, one-man operation. Powered to clean the hardest scale and deposits. Built-in flushing system removes chips, cools bit.

TUBE CLEANERS . . . full selection of motors and cleaning heads for every type tube . . . straight or short bend. Flexible shaft and universal joint for easy operation.

GRINDERS . . . and Airetool also produces a complete line of vertical and horizontal air-powered grinders for snagging, buffing, wire wheel work, sanding and all types of grinding.

For complete information and demonstration, call your Airetool representative today . . . or write us direct.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Representatives in the principal cities of the free world

OVER 30 YEARS' EXPERIENCE IN PNEUMATIC TOOLS

For more data circle 536 on Post Card

Designed specifically for **Hot Water** *Operation*

with...

Venturi-Action Mixing-Tube

Venturi-Action Mixing Tube
plays a triple role:

1 It starts by mixing entrained water from the boiler with water entering the boiler.

2 Traveling through the tube, temperature is further modified by the surrounding water.

3 Jet action at the end of the tube directs flow downward and outward against the outer confines of the shell, providing a circulation pattern unequalled in any other hot water boiler.

SUPERIOR "TYPE CC"

This new Superior Hot Water Boiler eliminates the problems resulting from the use of steam boilers for hot-water heating. Most of these stem from improper circulation within the boiler.

Its newly designed Venturi-Action Mixing-Tube achieves a more effective use of the natural flow pattern for maximum efficiency in hot water heating.

In addition to its special hot-water design, features include 4-pass down-draft design, 5 sq. ft. of heating surface per bhp., built-in induced draft, fully automatic operation firing gas, oil or both, and a host of other features described in detail in the new catalog illustrated at left.

For sizes to 11,720,000 Btu's/hr., write for catalog CCW-12.
For sizes to 20,100,000 Btu's/hr., write for catalog CFW-12.

Fire-Tube and Water-Tube PACKAGED BOILERS
for STEAM or HOT WATER

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N. Y.

SUPERIOR PACKAGED BOILERS ®

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Current Catalogs

continued from page 28

line post insulators which incorporate wide wire grooves, higher mechanical strength and improved seals.

148 Trimming Potentiometers—Included in this product bulletin of Con-Elco Div., Edcliff Instruments, on miniature wire wound trimming potentiometers and variable resistors is a table of standard resistance values and resolution in percentage, temperature curves and specifications.

149 Potential Devices—Application, construction and operation details on potential devices for low-cost voltage monitoring through 161 kv are covered by S & C Electric Co. in Bulletin 745, with circuit diagrams and engineering specifications.

Lighting

150 Mercury Lamps—Technical information on initial and maintained lumen output, life ratings and essential electrical and physical characteristics of mercury lamps is presented in 28-pp Booklet A-7264 by Westinghouse Electric Corp. Also described are lamp construction, auxiliary equipment.

151 Mercury Luminaire — Booklet SA-8869 describes Westinghouse Electric Corp.'s 750- and 1000-w mercury-lamp luminaire for bringing daytime safety to heavily traveled roadways.

152 Fluorescent Lamp Ballasts — This 16-pp handbook by Universal Mfg. Corp. details operation and care of fluorescent ballasts with recommendations for obtaining proper performance from a fluorescent lighting installation.

153 Fluorescent Lighting Guide — Theoretical and practical facts on fluorescent lighting its advantages are presented by Sylvania Electric Products Inc. in this 20-pp new edition of their popular reference guide. Sections on various types of lamps and accessories, cost estimating and lamp replacement data included.

154 Sealed-Beam Floodlight — Bulletin 2727 describes Par-Beam, designed by Crouse-Hinds Co. for economical, effective outdoor illumination, providing footcandle charts, dimensions, lighting selector information, plus many exclusive features and accessories. Various models shown accommodate lamps from 75 to 500 w.

Other Equipment

155 Rental Heating Equipment — Form 6596 introduces Iron Fireman Mfg. Co.'s lease plan covering gas and oil burners for heating and power; packaged generators for steam and hot water; and heating and temperature

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JULY, 1961

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control systems. Explains how rental plan enables use of fuel saving, low maintenance modern equipment without capital investment, discusses other advantages.

156 Dry Materials Conditioner—Featured in Bulletin 5002-2 by Johnson-March Corp. is the Verticone conditioner for dustfree handling of bulk dry materials by continuous controlled wetting.

157 Process Water Filters—Circular and flat leaf vacuum filters, screw type feeder and chlorinator for filtration of industrial process water are featured in 8-pp Bulletin Ref. No. 1860.20-2 by B-I-F Industries. Dimensions, capacities, flow diagram and engineering data included.

158 Improved Concrete — Performance of Pozzolith concrete in combating weathering, freezing and thawing, saturation with water and chemical corrosion in water and sewage works is detailed in 20-pp Bulletin MBR-P-5, by The Master Builders Co.

159 Industrial Machinery—Among machinery described in 24-pp Bulletin 293, by Nordberg Mfg. Co., are diesel, dual fuel and gas engines for municipal and industrial power plants, pipe line pumping and other applications; gyratory and cone crushers, vibrating screens, grinding mills, kilns, others.

160 Welded Pressure Tubing—Characteristics and advantages of electric resistance welded steel pressure tubing for use in various heat transfer applications are detailed in this product bulletin by Revere Copper and Brass Inc.

161 Magnetic Tape System—Details on an integrated multichannel wideband data recording and reproducing system designed to handle precision data in frequency spectrum from d-c to 500 kc are presented in Bulletin 2600 by Consolidated Electrodynamics Corp.

162 Atomic Power Plant — Principles of atomic power generation are explained in this 10-pp booklet on Consolidated Edison Co.'s Indian Point Atomic Power Plant. Design features of Indian Point are illustrated.

163 Insulating Firebrick — Advantages of insulating firebrick, as well as charted information on a variety of applications, are presented in 36-pp Bulletin R-38 by The Babcock & Wilcox Co. Includes drawings of fire-brick constructions, and basic application and selection data.

164 Air-Powered Soot Blower — Long retractable soot blower designed to give thorough cleaning of all heating surfaces is illustrated and described in 8-pp Bulletin 1073 by Blaw-Knox Co.

165 Weed, Brush Control—This 12-pp bulletin is a guide to industrial vegetation problems and selection of the right chemical or combination of chemicals for their control. Facts about weed and brush killers are presented by E. I. du Pont de Nemours & Co.

When you need fast, easy opening and closing with a leak-proof seal and straight-through flow with minimum pressure drop specify

EVERLASTING

BOILER BLOW-OFF
Quick acting, also handwheel operated "Y" and angle types. For pressures up to 600 psi.

GENERAL SERVICE
Where drop-tight seal and full flow is essential.

CYLINDER OPERATED
Can be remotely controlled, electrically or manually.

STEAM JACKETED
Assures free flow of viscous materials.

WEIGHT-OPERATED
For automatic drains or emergency shut off.

WRITE FOR BULLETIN

EV-409

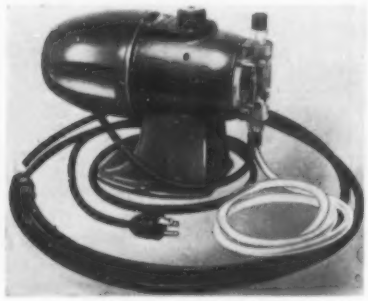
EVERLASTING VALVE COMPANY, 47 FISK STREET, JERSEY CITY 5, N. J.

For more data circle 538 on Post Card

Equipment News

1 — Diaphragm pump feeds corrosive water additives

This electrically driven chemical pump for feeding a chemical solution (sulfuric acid and others) in amounts to 1



gph against pressures to 100 psi, is available from The Bird-Archer Co. The diaphragm type pump offers good self-priming and air-purging characteristics, has simple, dial-adjustable feed rate control. It operates at 30 strokes per minute, weighs 8 lb, has a single-phase 60-cycle 115-v motor.

2 — Protective film guards against electrical failures

Lectra-Shield is a protective coating formulated by Corrosion Reaction Consultants Inc. for use on totally enclosed motors, insulators, electronic gear, electrical equipment cabinets and painted or plated surfaces wherever long term protection is required against severe corrosive conditions. It forms a continuous protective film 1 to 8 microns thick and makes treated surfaces highly water repellent. Its thin film engulfs industrial contaminants that lower resistance values of electric gear, and it prevents deterioration of gaskets, seals and covers. Coating may remain effective less than a year or more than 5 yr, depending on conditions.

Described on these pages are new and improved products. Use 85-86 to ask for more information on them. Just circle item numbers of products in which you are interested.

4 — Catalyst promotes combustion; reduces smoke, soot, scale

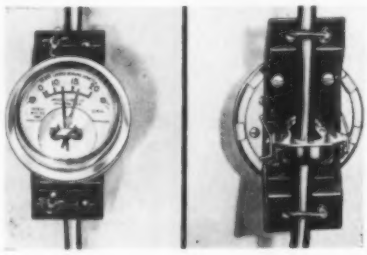
Utilizing a complex of metallic compounds, Harco Combustion Catalyst promotes more complete combustion of oil and coal and practically eliminates smoke, scale deposits and stack emissions. It is also an anti-corrosive in its effect in the flue gas passages, and can be modified to act as a carbon scavenger for diesel fuels. With fuel oil, 1 gal of the catalyst is added to 10,000 of oil; 1 gal is added to each 50 tons of coal. Manufacturer, Harco Chemical Co., states that users of high sulfur/vanadium content oils will find this catalyst a means of assuring clean, corrosion-free equipment, since more complete calcination of the ash components produces a dry, flocculent ash with high melting point.

5 — Infra-red detection system guards against illegal entry

Tattleguard is designed by Alnor Instrument Co. to provide invisible electronic curtain security for plants and property. The system scans up to 350 ft and operates day and night, indoors and outdoors. It consists of a transmitter and receiver, between which an invisible infra-red beam is passed. Upon interruption of this beam—by humans, animals, vehicles or vagrant objects—a relay in receiver is actuated to operate auxiliary alarm equipment.

3 — Load indicator determines distribution transformer loading

This low-cost ammeter by James G. Biddle Co. requires a 30-min lag, at an ambient temperature of 67 F, to indicate 95 per cent of the magnitude of a current change, held constant for that period. An indicating pointer follows current changes, and a red reset pointer indicates value obtained since last reset. Red pointer is reset by passing magnet across face of instrument glass. Attachment is described as simple, requiring no electrical connections. Instrument shown is rated at 20 amp full



scale, based on 200 per cent load, for use on 25 kva distribution transformers. Higher ratings are planned.

6 — High pressure gage works under extreme conditions

Rochester Series 6925 High Pressure Gauge is designed by American-Standard Controls Div. for pneumatic or hydraulic service in chemical processing, petro-chemical and other high-pressure applications up to 10,000 lb. According to manufacturer, the unit has a life expectancy of 250,000 cycles and will provide continued accuracy of pressure measurement under overload pressures, high vibration, shock or line pulsation. Overall accuracy is given as ±¼ per cent, with hysteresis, friction and back-lash kept below readable limits. Unit has no moving parts, is equipped for flush or panel mounting.

7 — Reinforced plastic pressure pipe withstands 100 psi

Corrosion-proof reinforced plastic pressure pipe capable of withstanding pressures to 100 psi at temperatures as high as 250 F is announced by The Ceilcote Co. Duracor Pressure Pipe is available in 10- and 20-ft lengths and is furnished in fiber glass mat and cloth construction. Wall thickness ranges from ¼ to ⅝ in., depending on pressure and temperature requirements. It is suitable for above-ground or underground installation.

8 — Line post insulators have extra wide wire grooves

Available in five ASA sides from 23 through 69 kv, Locke Line Post Insulators of General Electric Co. feature a 1¾ in. wire groove to accommodate large aluminum conductors. Grooves

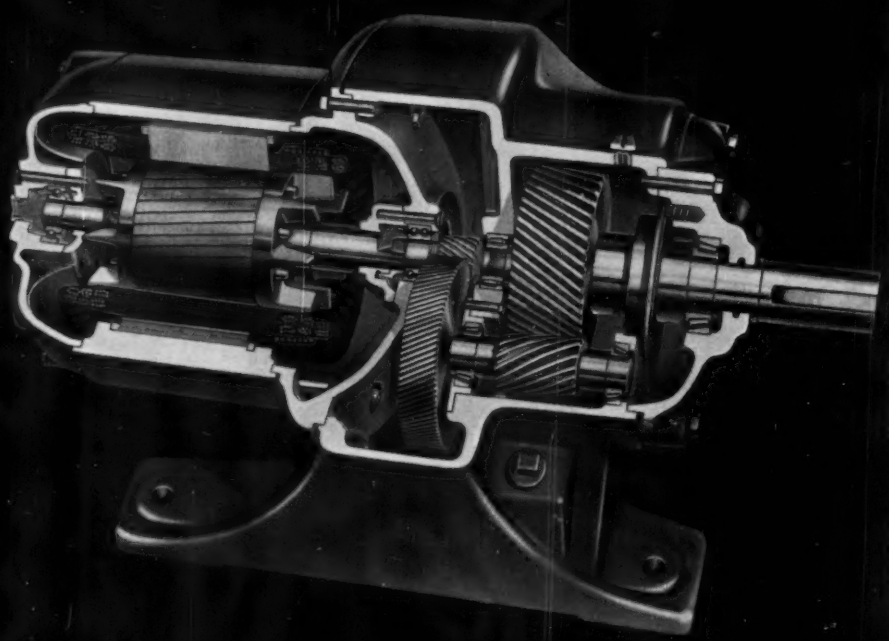
have circular depths of ⅝ in. in the lowest rating, ¾ in. in all other ratings. Developed to enable users to utilize a maximum range of conductor sizes, the insulators have a rated cantilever strength of 2800 lb, and unusually high impact strength. Also a feature is use of a metal disc to seal the unit air tight and keep moisture out of the porcelain column.

9 — Adjustable 4-ton gantry crane folds up for storage

Magic-Pole Universal Gantry can be dismantled by removing its caster frames, closing its telescoping legs and folding them against the I-beam. When disassembled, there are only three basic sections. The crane may also be lowered

designed for LONG LIFE ...life-long dependability

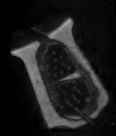
Only U.S. SYNCROGEAR has all these features...



RUGGED PYRAMIDAL CASE prevents distortion or misalignment.

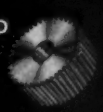
SOLID SHANK BUILT-IN PINION can't vibrate or work loose.

ASBESTOS PROTECTED WINDINGS will not deteriorate from heat.



ONE-PIECE SUPPORTING CASE assures permanent alignment of gears, pinions.

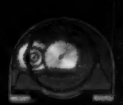
THROUGH-HARDENED GEAR TEETH give greatest strength, longest wear.



NORMALIZED CASTINGS prevent warping, misalignment of gears, shafts.

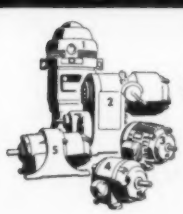
FRICTION-FREE OIL SEAL can't wear, prevents leakage.

POSITIVE AUTO-LUBRICATION by slow-gear dip prevents churning



MICRO-SHAVED AND HONED GEAR TEETH provide smooth operation, long life.

U.S. SYNCROGEAR MOTORS offer the *most features* to provide long life and dependability. For a quarter-century, U.S. Syncrogears have led design progress. (Available 1/3 to 75 h.p.—single-, double-, triple-reductions, and worm-geared.)



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FREE SYNCROGEAR BROCHURE No. F-1880
Color illustrated

U.S. ELECTRICAL MOTORS INC.
P.O. Box 2058 • Los Angeles 54, California or Milford, Conn.

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and narrowed for rolling under fire doors, into elevators etc. At the job it can be raised to maximum height and its casters spread wide for stability. Telescoping legs adjust separately, allowing setups on different levels. A self-traveling I-beam is also provided for off-center loads. Five models are available with steel or aluminum alloy I-beams in spans to 30 ft, heights to 17 ft, capacity to 4 tons. B. E. Wallace Products Corp. manufacturers of the Magic-Pole.

10 — Pneumatic operators for remote valve actuation

Automatic or pushbutton remote control of Hills-McCanna Co.'s ball valves is provided with these pneumatic operators. Vertically mounted models for valves from ¼ through 8 in. are totally enclosed and permit closer spacing of automated valves in series. Horizontally mounted cylinder-and-lever type operators for valves from 3 through 8 in. cost less than the top-mounted type; also their over-all height is less for more convenient mounting in restricted areas. Both types are sold with valves or separately for installation on valves already in service. Optional accessories include a solenoid valve for electrical control, limit switch for remote on/off indication, and a fail-safe device. Catalog 1200 gives information.

11—Economical cutout protects low fault capacity systems

Designed specifically to provide economical overcurrent protection for low fault capacity systems, Type EDD Cut-

outs are rated 100-amp continuous current at voltages of 7.8 and 15 kv and meet NEMA distribution cutout voltage withstand requirements. They interrupt full range of fault currents from slight overloads to interrupting ratings of 3000 amp at 7.8 kv and 2000 amp at 15 kv. They are produced by Line Materials Industries, McGraw-Edison Co.

12—Luminaire directs uniform light to a large area

Type OV-50 Silverliner, a lighting luminaire for 700- and 1000-w mercury lamps, is designed by Westinghouse Electric Corp. for illuminating roadways and parking lots. A latch allows easy access to the lamp, and keeps out bugs, dirt and moisture. The fixture's aluminum finish resists heat, abrasion and corrosion. Two styles are available —one with a built-in regulated output ballast (with a capacitor housing which fits on top of the luminaire) and one with remote ballast operation. Lamps can be controlled by photocells.

13 — Turbine pump for high head, low capacity service

Introduced by Worthington Corp., this turbine pump operates on pressure regeneration, by which a multi-vaned impeller engages and re-engages the liquid to develop high heads in a single

stage. This regeneration cycle is repeated as many as 50 times as pressure is built up in the pump. When the liquid reaches the discharge opening, it is allowed to escape and a close clearance stripper in the plates prevents the flow from continuing on to a suction area. The stripper lets the pump operate with large amounts of entrained gas, or vapor, which may have been formed due to high vapor pressure of the liquid handled. A feature is replaceable casing plates. The pump is available as a close-coupled monobloc pump as well as frame mounted.

14 — Dustproof capacitor with ratings up to 25-kvar

These industrial dustproof capacitors are available from Westinghouse Electric Corp. for 480- and 600-v use, single or three-phase with no increase in size, weight or dimensions over the 20-kvar rating of the same voltage. Individual units provide corrective capacity near the load, when connected to machine terminals or at load centers. By switching through the motor or load-center controls, separate switches are not required. The dustproof design protects against entrance of foreign matter and isolates live parts from accidental contact; terminals, fuses, and connections are accessible by removing the spring-clipped cover. The capacitors can be floor, wall or ceiling mounted. When mounted in multiple assemblies capacity can be changed by adding or subtracting units, or by substituting units of other ratings.

15 — Current transformer testing equipment with 34 ranges

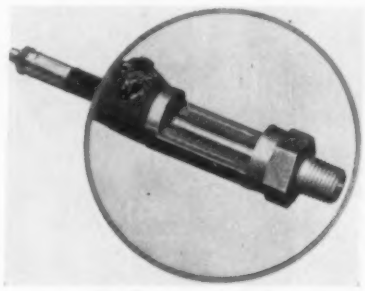
Uniload current transformer testing equipment, Type GCT-1, with ranges from 5 to 6000 amp is designed by Knopp Inc. for testing instrument transformers. The equipment contains a current-loading transformer, multi-range current transformer standard, built-in ASA standard burdens, and a transformer comparator for reading ratio error and phase angle from dials. It also includes a variable-transformer current control, switches, over-load protection in a console cabinet with controls and devices conveniently located for use. Accuracy of equipment can be checked by the one-to-one method.

16—Photo control for outdoor lighting applications

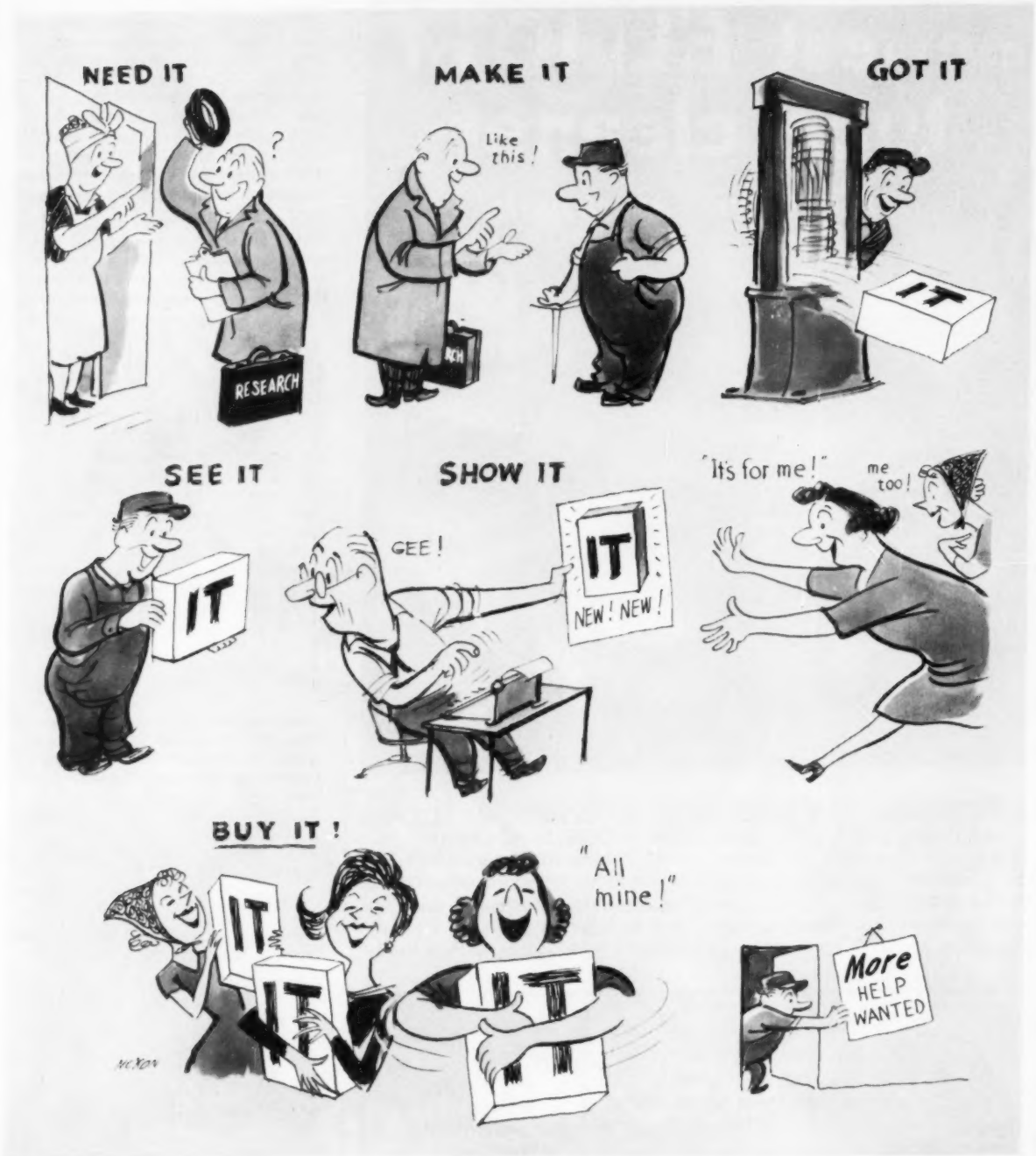
This quick-response control is for lighting applications where extended time delay is not desired. It functions automatically to control any lighting circuit or individual luminaires. It is built around company's cadmium-sulfide photoelectric cell, reported by General Electric to have the lowest failure rate established, and this cell is combined with a simplified circuit and minimum of components. Control incorporates hermetically sealed rectifier and relay with contacts normally-closed for "fail safe" operation. Components are mounted on a printed circuit board having multiple air gaps to protect against surges in excess of 1400v. Control will switch up to 1000 w incandescent load, or 1800 v-amp mercury vapor or fluorescent load. It has an operating range of 0.5 to 3.0 ft-c, can be had for 120- or 240-v operation. Publication GEA-7230 describes it.

17 — Wire-reinforced hose withstands high pressure

According to Anchor Coupling Co., Inc., Super-Spiral 6-Ply Wire-Reinforced Hydraulic Hose can stand minimum burst pressure of 50,000 psi., and



under testing conditions, 56,000 psi. Suitable within temperature ranges of —40 to 200 F, the six-ply construction starts with an oil-resistant Neoprene inner tube, covered by an open textile braid reinforcement. Interply friction layers cover six plies of spirally wrapped heavy wire reinforcement. A syn-

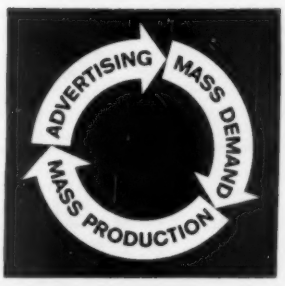


IT means better living for you

Once a manufacturer was looking for a better product. "I want to be sure that people NEED IT," he said. So he asked a lot of them about IT. The answers told him how to MAKE IT. Finally he GOT IT. But IT cost an awful lot to make. To sell it for less, he'd have to make IT by the million. Which meant IT had to be sold by the million, too.

So he let his advertising man SEE IT. Ads began to SHOW IT to millions who might LIKE IT enough to BUY IT. And they did. For IT was indeed a product that they needed, at a price they could afford to pay.

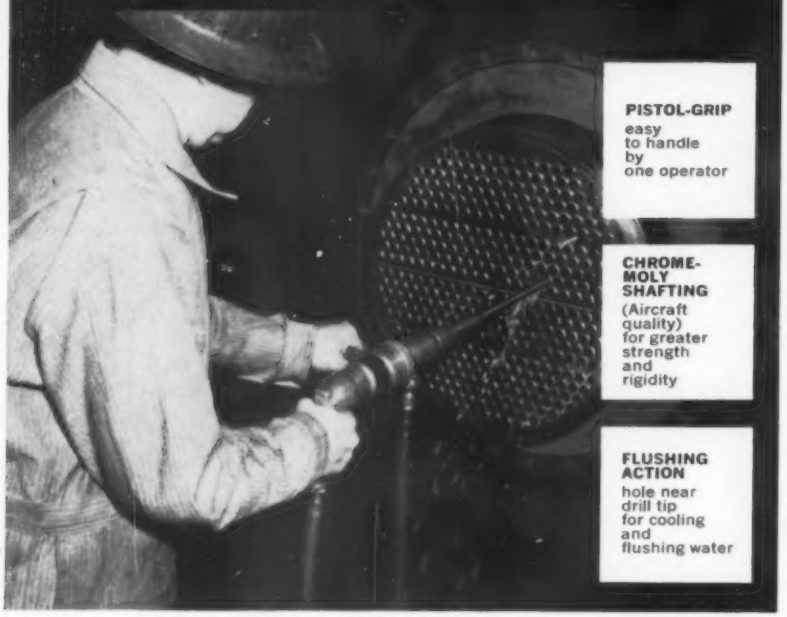
Then a big sign, MORE HELP WANTED appeared on the factory door. Everybody was happy, for now they had IT made.



Let's Keep Rolling Ahead

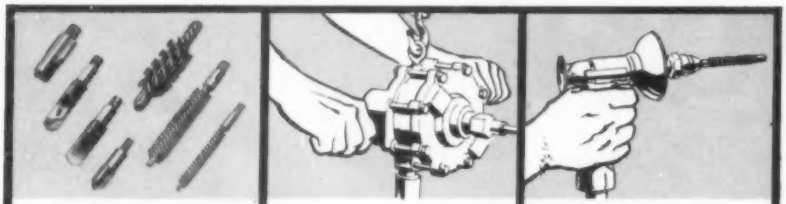
newest ELLIOTT tube cleaner

lightweight! air-driven!


PISTOL-GRIP
easy to handle by one operator
CHROME-MOLY SHAFTING
(Aircraft quality) for greater strength and rigidity
FLUSHING ACTION
hole near drill tip for cooling and flushing water

for condenser and heat exchanger tubes

Lightweight. Powerful. Air-driven. Trigger-action control with speed governor to prevent shaft-whip. High-speed motor reduced through planetary gears to 1500 rpm. Integral water-feeding attachment with finger-action valve which controls flow of cooling water into hollow shaft and drill or brush. Built-in oil reservoir. Send for tube cleaner bulletin Y-48.



DRILLS AND BRUSHES FOR VARIED NEEDS
Brushes for light deposits. Four types of drills clean light, hard-heavy, hard-light, and gummy deposits.

SUSPENSION TYPE
Air, steam or electric heavy-duty motor, for removing hard, heavy deposits. Ball bearings absorb thrust in either direction.

ELLIOTT JIFFY GUN
For extra-fast cleaning of light deposits in tubes ½ in. to 1¼ in. Air or water pressure shoots nylon brushes or rubber plugs through tubes.

ELLIOTT COMPANY
GENERAL OFFICES: JEANNETTE, PENNSYLVANIA
PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio; Newark, N. J.
TURBINES • GENERATORS • MOTORS • COMPRESSORS • TURBOCHARGERS
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Y1-9

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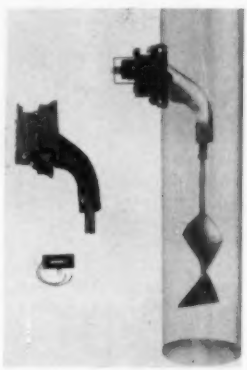
thetic rubber outer cover resists sun, weather, oil and abrasions. Spiral construction permits use of heavier wire and eliminates crossing of wires. Hose is available from ⅜ to 1½ in. I.D. Catalogs 102 and 403 give details.

18—Meter for volumetric measurement of granular materials

This solids flow meter introduced by Bailey Meter Co. measures total flow of granular material such as coal, ore, and crushed rock in vertical ducts, spouts or pipes with diameters up to



40 in. A helical quarter-turn vane in the pipe converts velocity of flowing materials into rotational speed. Rotary motion is carried out of the pipe by a flexible shaft and a set of change gears. Shaft operates a direct mechanical counter or an electric contact mechanism to operate remote counter. An 8-in. diam vane for 20-in. diam pipe and a 16-in. diam vane for 40-in. pipe are available. Air purge system keeps bearings clean.

19 — Cable suspension system can be placed in tension

Line-Flex Cable Suspension System, of Perfect-Line Mfg. Corp., offers flexibility in one plane or non-sag rigidity in opposing plane and needs no special equipment or tools to install. It is de-

signed for use in non-supported rigid lengths up to 14 ft or catenary applications involving lengths of 400 ft or more. Line-Flex may be placed in tension without distortion or damage, according to manufacturer; in obstacle-studded installations, it can be bent along its flexible plane using radii

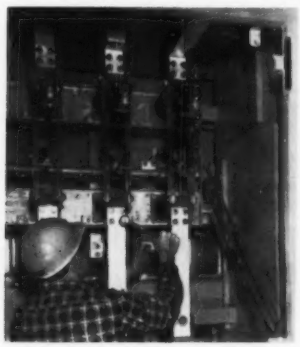
much smaller than allowed equivalent standard conduit, and several hundred feet of cable may be pulled through as many as three 90-deg angles by hand. Installation costs are claimed less than those of other methods, and Line-Flex may be dismantled for re-use. Line-Flex dissipates heat by radiation and convection. Single cable lengths may be used at free-air rated capacity, and in multiples at reduced ratings. Line-Flex comes in zinc coated or stainless steel, in several diameters.

20 — Positioner for control valves and pneumatic drives

For use with diaphragm or piston-operated control valves, and with pneumatic drive units, this valve positioner will accomplish full travel in less than 2 sec, according to Blaw-Knox Co., on an average valve with 1-in. stroke and operator area of 100 sq in. Pilot has long-stroke valve giving proportionalizing characterstics for maximum steady-state stability. Position feedback restores balance after load change. Standard long-travel cams offer linear or square-root characteristics, or may be given throttling characteristics. Positioner may be direct- or reverse-acting, can be changed in the field.

21 — High-voltage load interrupter switch costs less

This three-pole load interrupter switches up to 1200 amp, closes on 60,000 amp when fused, and according to S & C Electric Co., costs up to $200



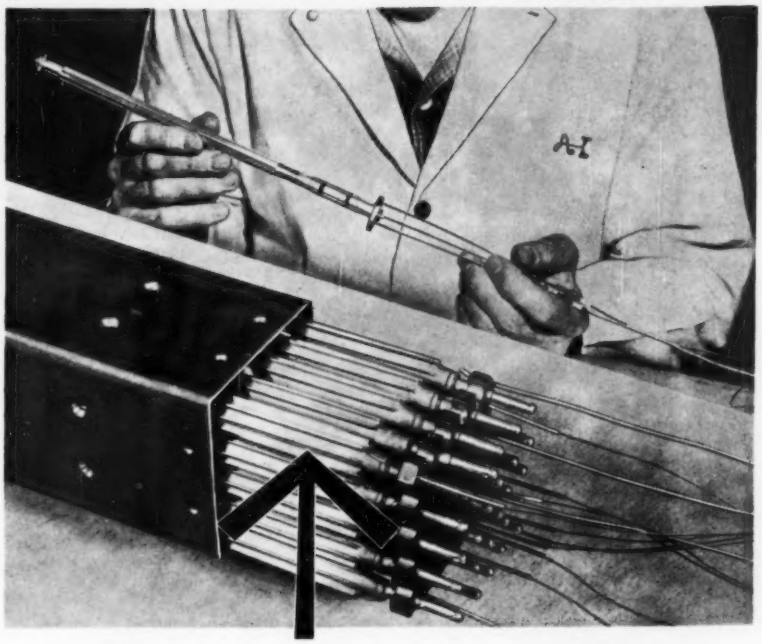
less than former models that could carry 1200 amp but interrupt only 600 amp. More compact, too, the switch uses parallel blades, has dual contacts and includes integral quick-make, quick-break mechanisms. Nominal voltage ratings are 4.8, 13.8 and 14.4 kv with continuous and interrupting rating 1200 amp. Momentary (10-cycle) rating is 61,000 amp. Fault-closing rating is 40,000 amp without fuses and 60,000 amp with fuses.

22 — Liquid detergent cleans practically all surfaces

CalClean is a heavy-duty detergent for cleaning evaporator coils, metal air filters, fans and other surfaces coated

from ALCOA

good designs made better with aluminum



Atomics International's nuclear fuel elements operate at 900°F with new Alcoa finned tubing

This finned Alcoa® Aluminum tube, being checked by a technician of Atomics International, a division of North American Aviation, Inc., Canoga Park, Calif., will go into a nuclear fuel element for organic moderated and cooled reactors operated for the Atomic Energy Commission. Fabricated by Alcoa from APM (aluminum powder metallurgy) alloys, the remarkable tubes permit reactor operation at temperatures up to 900°F, marking an important step forward in the development of economical power from atomic energy. Tests pointed up other features of Alcoa APM alloys: high thermal conductivity, low neutron absorption, excellent corrosion resistance in organic coolants. For more about aluminum's other advantages, please send the coupon.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Aluminum Company of America, 828-UU Alcoa Building, Pittsburgh 19, Pa.
Please send me the following literature:

☐ 34-11566 *Alcoa Aluminum Heat Exchanger Tubes*
☐ 24-10551 *Impacts—Metal in Motion*

Name_____ Title_____
Company_____
Address_____
City_____ State_____ Zone_____

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THE LONERGAN LINE

A. J. Schmidt
Chief Engineer

SIZING SAFETY VALVES

by A. J. Schmidt, Chief Engineer

Selection of a safety or relief valve should be made on the basis of the capacity requirements of the application, rather than on pipe size alone. Using pipe size as the sole basis may result in a valve with far greater capacity than required and the valve may chatter on the installation due to a "starved" condition. On the other hand, pipe size selection may provide a valve with too little capacity, which will not give adequate over-pressure protection.

It is much better to select a safety or relief valve for the actual capacity requirements of the system. This will reduce the initial cost and will keep operating costs down because proper operation and protection will be obtained.

Lonergan safety and relief valves provide additional cost advantages due to the high capacities provided for any given pipe size. Thus, you can specify the smallest possible valve to meet your capacity requirements. Lonergan V, W, 11-W, and 41-W series safety valves also provide all the advantages of top guided, nozzle valve construction and two-ring positive control as embodied in Lonergan Patent No. 2414794.

Complete descriptions of Lonergan safety and relief valves for all applications are in catalogs 900-V and 1000-V. Write for your copy to the address shown below.

Alvin J. Schmidt

Lonergan

J. E. LONERGAN CO., 207 RACE STREET
PHILADELPHIA 6, PA. SINCE 1872

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with grease and dirt. It can be used on almost any metal, wood, cement, glass, tile, linoleum or painted surface —a concentration of 1 or 2 oz per gallon of warm water is recommended. A product of Calgon Co., Hagan Chemicals & Controls, Inc., the all-purpose cleaner contains surfactants, grease solvents, alkaline cleaners, corrosion inhibitors and water conditioners. It is formulated to dissolve soil residues, grease and dirt, but is mild enough for washing hands when mixed with water. CalClean is reported most effective when applied with a suitable compressed air sprayer.

23 — Electrostatic precipitator has flat collector plate

High collection efficiency of this electrostatic precipitator, available from American-Standard Industrial Div., is attributed to flat collector plate design with "pockets" which trap and hold dust, reducing chance of reentrainment. Unit is custom built to

suit the job and features modular construction. Advantages noted include improved clean plate sparking voltage, increased migration velocity of dust particles to collecting electrode, better performance with high resistivity dust, less turbulence. Four types of high voltage rectifier are available: silicon, selenium, high voltage vacuum tube or mechanical. Control can be either a saturable reactor, a monocyclic network or a resistor type, with full automation

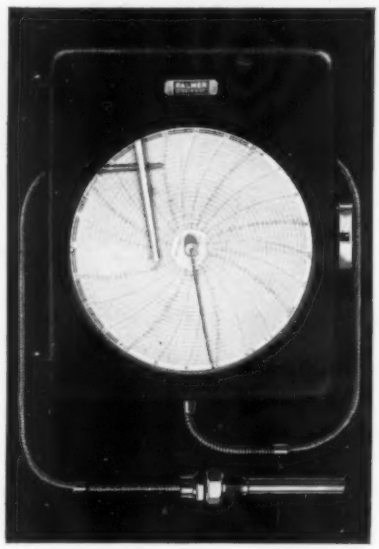
24 — Control valves designed for bubble-tight shut off

Spanseal Control and Line Valves are announced by Ledeen, Inc., as offering versatile internal flow configurations, low shifting force and small linear valve movement, as well as bubble-tight shut off. Control valves are available for 1500 psi pneumatic and hydraulic service and —40 to 250 F temperature range. They come in four-, three-, and two-way diverter and shuttle cycles, with attachments for low and high pressure, solenoid, manual and cam operation. Line valves are uni-directional shut-off valves with internal actuator available in

PALMER

MERCURY ACTUATED RECORDERS

Into this modern Mercury Actuated Recorder has gone all the skill of Palmer Master Craftsmen



Readings are clearer, smoother and more precise than ever thought possible. In fact readings are so amazingly improved that maintenance is never needed under normal uses.

Recording Thermometers feature twelve inch die-cast aluminum case with black wrinkle or white satin finish. Single or multiple pen construction. Electric or spring wound clock, 24 hour or 7 Day Revolution. Flexible Armor and bulb of stainless steel. Ranges: —40 to 1000°F. or Equivalent in °C.

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straight shut-off cycle or as shut-off valves with downstream vent for services requiring tight shutoff of upstream pressure while venting downstream. Bulletin 5000 provides data.

25—Insulating tape and fabric is flexible, resists tears

High-dielectric strength insulating fabric and tape made of 5J30, a black flexible varnish-treated Class B material of Dacron polyester and glass fibers is

announced by Westinghouse Electric Corp. Better flexibility, superior elongation properties and greater resistance to edge tear are advantages. Tensile strength for 0.008-in. thick material along major dimension is 43 lb per inch of width, across major dimension 109 lb, and dielectric strength is 2000 v per mil of thickness with ¼-in. electrodes. Material is available as tape, fabric.

26 — Sight-flow indicators for chemical processing

Brooksight Flow Indicators, introduced by Brooks Instrument Co., Inc., have no blind threads. Rotatable split-ring

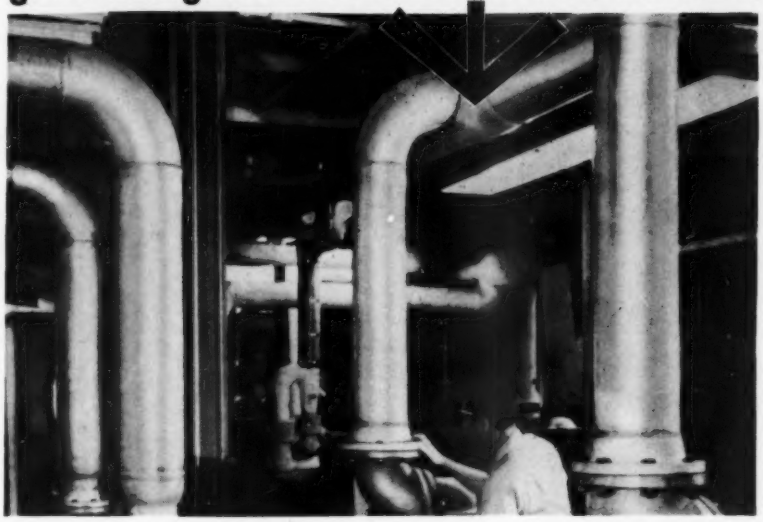
flanges allow precise positioning in pipe line for best viewing angle. Pressure ratings range to 500 psi, temperatures to 300 F. Cast iron, steel or stainless steel indicators, screwed or flanged, are stocked. Bulletin 820 gives details on these.

27 — Acid and alkali resistant paint available in colors

Chem-Rem, acid and alkali resistant paint in eight standard colors, as well as clear, matched shades and black,

from ALCOA

good designs made better with aluminum



All-aluminum cooling system reduces danger of water contamination in Brookhaven's new Synchrotron

More than one mile of aluminum piping and some 2,600 FLOWLINE aluminum fittings comprise the magnet cooling system at Brookhaven National Laboratory's new Alternating Gradient Synchrotron. High-purity water at 65°F is circulated through an aluminum piping system to cool electromagnets arranged in a one-half mile long circular ring; the water is then returned to heat exchangers. Because the conductivity of the water must be kept below 11 micromhos, aluminum was selected for its superior resistance to corrosion. View of pump room above shows sections of aluminum piping; FLOWLINE tees, elbows, and reducers, made with ALCOA® Aluminum by Flowline Corp., New Castle, Pa. For more information about aluminum's applications and versatility, please send the coupon.

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- ☐ 34-10418 Alcoa Unitrace: Combines Piping and Tracing in One Unit
- ☐ 68-10460 Process Industries Applications of Alcoa Aluminum
- ☐ 88-11453 Solving Refinery Corrosion Problems with Aluminum

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is announced by Speco, Inc. for protection of exterior and interior surfaces and piping. It is reputed to resist destructive effects of acetic, hydrochloric, dilute sulfuric acids, dilute caustic soda, bleaching solutions, ammonia and other alkalines. Its elastic surface is claimed impervious to moisture, smoke, chemical fumes and unaffected by oil, gasoline or temperature fluctuations. Applied by brush, spray, dip or roller, Chem-Rem dries to the touch in 30 min.

28—Improved var control for capacitor switching applications

The CJ-7 Var Control of Westinghouse Electric Corp. is available in two styles: one for wye systems, one for delta. Principal difference is that the wye control has zero torque when voltage and current are in phase; the delta control has zero torque when voltage leads current by 30 deg. Both are adjustable from 250 vars leading to 500 vars lagging. The two contact settings (close and trip) are independently adjustable through entire range providing the band spread between them is greater than the change produced by switching the capacitors. A feature retained from previous models in this new design are two thermal plug-in-type fixed time-delay relays, one in the close circuit and one in the trip circuit. They provide a predetermined time delay that eliminates unwanted switching operations from rapid system fluctuations of short duration. The fixed time delay relays are in the circuit only during automatic operation.

29—Metal-tube alarm rotameter cuts headroom requirements

Fig. 1900-F-CDA Rotameter of Schutte and Koerting Co. features a space saving design in which the visual indicating element and alarm system are included in one housing. The unit consists of a standard metal-tube rotameter for measuring fluid rate of flow and an alarm system, the latter including a magnetic indicator and alarm switches in protective housing The unit can be equipped with one or more alarm switches and with 10-amp relays when required. In operation, alarm switches are set for maximum and minimum flow. When flow is higher or lower than the settings, the switches activate a light, bell or other alarm, a start-stop switch or other control mechanism.

30 — Giant coupling for the high torque applications

Largest in the Para-flex line of flexible cushion couplings of Dodge Mfg. Corp. is the PX280. It has more than twice the torque capacity of the next smaller size and features the standard tire-shaped flexing element to accommodate angular and parallel shaft misalignment, to absorb end float, shock and vibration. The PX280 will handle 400 hp per 100 rpm; its capacity at maximum recommended speed of 910 rpm is 3640 hp. Available from stock with Taper-Lock bushings for shafts up to 7-in. diam, it may also be had bored-to-size for shafts up to 9 in.

31 — Insulating fire brick for prepared atmosphere furnaces

Two types of high purity fire brick for use in prepared atmosphere furnaces are announced by Johns-Manville. Both are suitable for direct exposure and back-up insulating purposes: the JM-23 for service to 2300 F, and the JM-20 for service to 2000 F. Made from clays having low iron content, they are

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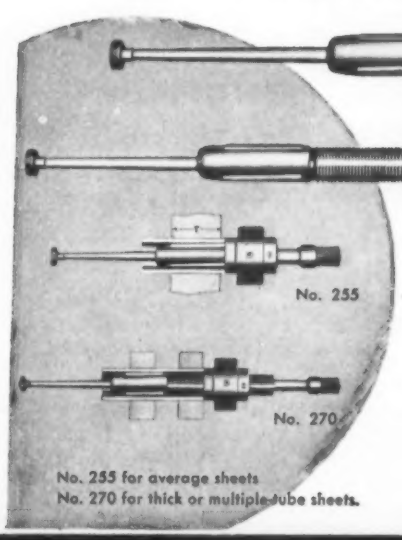

No. 255 for average sheets
No. 270 for thick or multiple-tube sheets.

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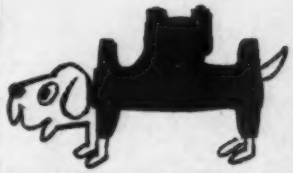
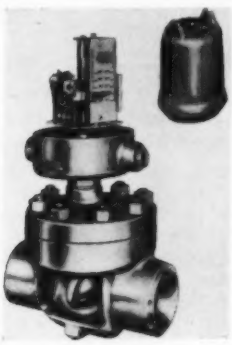


Be sure to see our family portrait on page 25

light in weight, with uniform pore structure, low heat storage capacity, and low thermal conductivity. Light weight, high insulating and load bearing values make possible thinner wall construction and minimum support.

32—Swing-check valve doubles as flow control unit

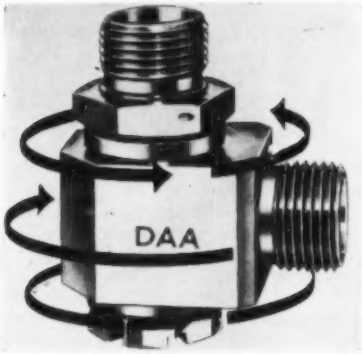
Model FCV, introduced by Magnetrol, Inc. is a full-flow, swing-check valve combining advantages of a check valve and a flow control, for practically any liquid at any pressure or temperature,



in one compact package. Valve disc is magnetically coupled to switch mechanism, having mercury-to-mercury switch contacts. Pneumatic pilot mechanism can be substituted for standard electric switch mechanism as an optional feature. Field adjustable unit is designed to remotely signal flow or no-flow through the valve; and/or provide an interlock safety control in start-up or shut-down, flow or no-flow. It can also indicate position of valve at any point from full closed to full open.

33—Low torque swivel fittings have broad application

This swivel unit offers universal application in fluid line systems and can be used with most flow media. A compact, lightweight assembly providing 360-deg rotation, with capability of operating at extreme temperatures and up to 5000 psi, it is pressure balanced and not subject to separation forces. As an example of its low torque, the 1-in. tube size has a torque less than 4



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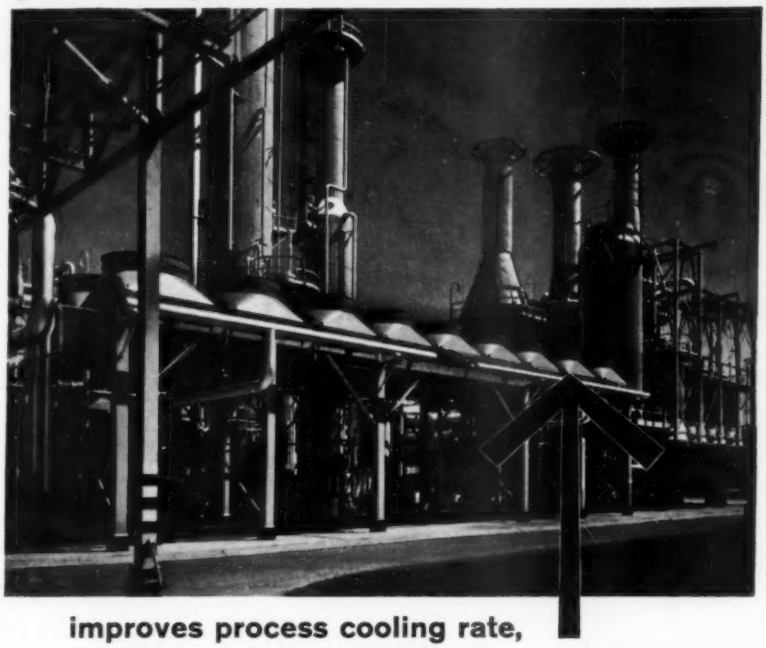

improves process cooling rate, resists corrosion at Southwestern Oil & Refining Company's Big Texas Refinery

Aluminum's superior ability to transfer heat finds practical employment in this Solo-Aire cooling installation, made with ALCOA® Aluminum by Hudson Engineering Corporation, Houston, Texas. Light, bright aluminum has other advantages here: notable corrosion resistance and remarkable low-temperature properties. Installed at Corpus Christi, Solo-Aire is clear evidence of another good design made better with aluminum. Perhaps ALCOA can help improve your good designs. For more information, please mail the coupon.

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- ☐ 88-11453 Solving Refinery Corrosion Problems with Aluminum
- ☐ 02-19051 Alcoa Aluminum Handbook
- ☐ 42-20849 Resistance of Aluminum Alloys to Weathering and Resistance of Aluminum Alloys to Chemically Contaminated Atmospheres
- ☐ 34-20437 Aluminum Alloy Heat Exchangers in the Process Industries

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One further advantage of Fast's Couplings' misalignment ratings: You save money on installation because, knowing the ratings, you don't have to line up driving and driven elements with pinpoint accuracy. It's one more important reason why Fast's Couplings are the choice of more equipment manufacturers than any other gear-type coupling.
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in./lb at 3000 psi. Manufacturer of the unit, Dumont Engineering Co., also announces a series of templates illustrating standard sizes from ⅛ through 2 in. OD tube size. Templates are actual size, show both end and side views and are also sectional to show internal arrangement of parts.

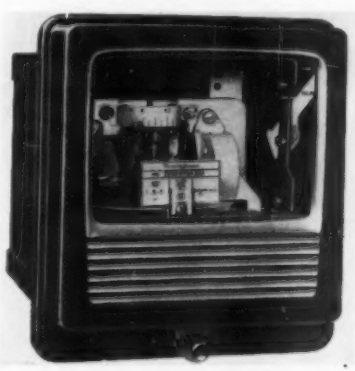
Reader Service Cards on pages 85-86 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

34 — Control valve for high pressure liquids, gases

Series RB, introduced by Conoflow Corp., is a split-body, barstock control valve for high pressure liquids and gases. Built up to 2500 lb ASA rating, it is suitable for 6000 psig cold working pressure, and comes in steel and 347 stainless steel in straight-through and angle construction, sizes ½ through 1 in., with variety of end connections. Standard throttling control is the Cylinder Conomotor with integral Model J positioner, but valve is also available with spring-and-diaphragm actuator for on-off service and handwheel actuator for manual throttling. Data Sheet 103 gives details.

35 — Current-sensing relay in tapped or nontapped units

Type COD Current-Sensing Relay with independently adjustable high- and low-current stationary contacts for switching and control operations is available with tapped or non-tapped electromagnet, from Westinghouse

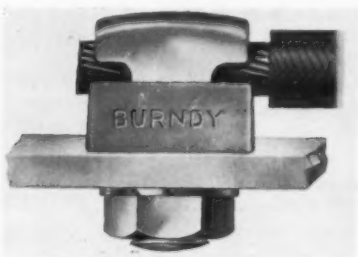


Electric Corp. Tapped relay is supplied in ranges 0.5 to 2.5, 2 to 6 and 4 to 12 amp a-c, with scale marked in per cent of tap value from 80 to 110 per cent. Nontapped unit comes in 0.5 to 2.0 or 1.5 to 6 amp a-c, and scale is marked in amperes. Minimum setting between high- and low-current contacts is 3 per cent of tap value for

tapped and 0.1 amp for nontaped relay. Tapped relay has burden of 2.38 va at minimum setting and nontapped has 0.48 va at minimum and 7.6 at maximum. Moving contact moves according to current applied; since relay has inverse timing, the greater the change in current, the faster the moving contact will travel.

36 — Electrical connectors are low-cost, versatile

Low cost range-taking Bartaps are introduced by Burndy Corp. for joining cables to flat bar, connecting from two



to four hole transformer pads to transformer leads or connecting ground cables to steel structures. They are available in range of sizes for No. 10 Sol through 2000 mcm cable and ¼- through ¾-in. bar thickness.

37—Pipe insulation jacket resists fire and humidity

Flame-Bar, a white embossed flame-retardant vapor-barrier jacketing for pipe insulation is reported to have a UL flame spead rating of 25. A product of Johns-Manville Corp., it can be obtained on company's Micro-Lok, Fibrocel and Thermobestos insulations. According to manufacturer, Flame-Bar incorporates all good characteristics of other flame-retardant jackets, with no wrinkling under high humidity conditions, yellowing with age, or pinholes. Of three-ply construction it has an outer layer of 35-lb bleached embossed kraft bonded to aluminum foil with a flame-extinguishing adhesive. It is reinforced in lamination with fiber glass yarn. It has a water permeability rate of 0.01 perms and can be painted or color coded.

38 — Bus fittings designed for operation up to 345, 460 kv

Weld-type corona-suppressing electrical bus fittings are announced by Southern States Equipment Corp. The expansion-type stud connector is designed for corona-free operation up to 345 kv, other arrangements are available for application at 460 kv. Integral-shield design eliminates external grading rings. Expansion unit is welded throughout. Recessed bolts mount unit at desired angle to stud clamp. Other types of fittings are available for aluminum substation bus.

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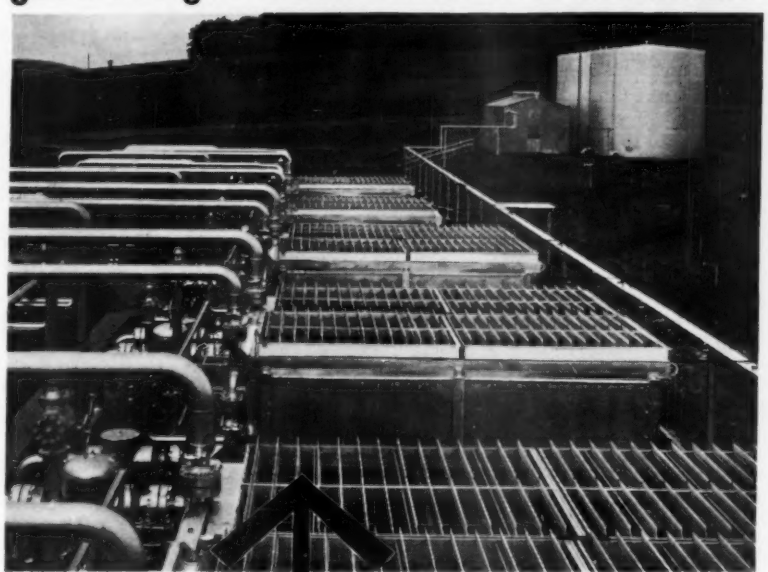

Alumi-Louvers provide dependable, economical ventilation at New York State Natural Gas Co.

For uninterrupted, maintenance-free performance, Mansfield Metal Fabricating Co., Mansfield, Ohio, constructs its famous *Alumi-Louvers* of Alcoa® Aluminum. A typical installation (shown) is at New York State Natural Gas Co., Tamarack, Pa. *Alumi-Louvers* require no maintenance, provide dependable, economical control of ventilation and temperature. Mansfield reports that lightweight aluminum cuts transportation and installation costs (special rigging is unnecessary). For more information about corrosion-resistant aluminum, please send the coupon.

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Advertisers' Index

Aerovent Fan Co., Inc. ..... *
Air Preheater Corp., Inc. 23
Airetool Mfg. Co., The 83
Allis-Chalmers Mfg. Co. 18-19
Aluminum Company of America 93, 95, 97, 99
American Oil Co. 77
American Pulverizer Co. ..... *
America-Standard Industrial Division .. *
Ames Iron Works, Inc. ..... *
Anaconda American Brass Co. 5
Anderson Co., V. D. ..... *
Armstrong Machine Works 33
Atomics International ..... *

Babcock Wilcox Co., The Boiler Div. 10-11
Bailey Meter Company ..... Cover II-1
Baldwin-Ehret-Hill, Inc. 27
Barco Manufacturing Company 81
Beckman Instruments, Inc. ..... *
Betz Laboratories, Inc. 20-21
Biddle Co., James G. ..... *
Bird-Archer Co., The 80
Blaw-Knox Co. ..... *
Boyertown Auto Body Works 91
Brown Boveri Corp. ..... *
Buell Engineering Co. ..... *
Bussman Manufacturing Co. ..... *
Byron Jackson Pumps, Inc. ..... *

Cambridge Instrument Co., Inc. 102
Combustion Engineering, Inc. ..... *
Condenser Service & Engineering Co., Inc. ..... *
Copes-Vulcan Div., Blaw-Knox Co. . 28-29
Crane Co. 25, 96, 102
Crane Packing Co. ..... *

Dean Brothers Pumps Inc. ..... *
Dearborn Chemical Co. ..... *
Denver Equipment Co. 102
Detroit Stoker Co. 30
Diamond Power Specialty Corp. 16-17

Eagan Co., Inc., Walter H. ..... *
Eastern Gas & Fuel Associates ..... *
Edward Valves, Inc. ..... *
Elliott Co. 92
Ellison Draft Gage Co. ..... *
Engineer Co., The ..... *
Everlasting Valve Co. 87

Fairbanks, Morse & Co. 36
Fairmount Chemical Co., Inc. ..... *
Foster Co., Benjamin 2
Foster Wheeler Corp. ..... *
Fuller Co. ..... *

General Coal Co. ..... *
Globe Co., Products Div. ..... *
Goodall Rubber Co. 78
Graver Water Conditioning Co. 37
Grinnell Co. 22
Gruendler Crusher & Pulverizer Co. .. *

Hagan Chemicals & Controls, Inc. ..... 82, Cover III
Hall Laboratories ..... *
Hoffman Specialty Mfg. Corp. ..... *

Illinois Water Treatment Co. ..... *
Industrial Instruments, Inc. ..... *
Island Creek Coal Sales Co., The ..... *

Johns-Manville 14-15
Joy Mfg. Co. 9, 24

E. Keeler Co. ..... *
Kenco Pump Div. ..... *
Kirk & Blum Mfg. Co. ..... *
Koppers Co., Inc. 98, 102

Layne & Bowler Pump Co. 79
Leslie Co. ..... *
Lonergan Co., J. E. 94

Manning, Maxwell & Moore, Inc. ..... *
Marley Co. ..... *
Mansfield & Green, Inc. ..... *
Milton Roy Co. 38
Morton Salt Co. ..... *
Murray Iron Works Co. ..... *

Nagle Pumps, Inc. ..... *
Nalco Chemical Co. ..... *
Niagara Blower Co. ..... *
North American Mogul 35

OPW-Jordan Corp. ..... *

Pacific Pumps, Inc. A Division of Dresser Industries, Inc. ..... *
Palmer Thermometers, Inc. 94
Peabody Coal Co. 26
Peabody Engineering Corp. ..... *
Pfaudler Permutit Inc. ..... *
Pfizer & Co., Chas. ..... *
Pick Manufacturing Co. ..... *
Pickands Mather & Co. ..... *
Powell Valves, Wm. 73
Powers Regulator Co., The ..... *
Pratt Co., Henry ..... *
Pulsation Controls Corp. ..... *

Quickdraft Corp. ..... *

Raybestos-Manhattan, Inc. ..... *
Refractory & Insulation Corp. ..... *
Reliance Gauge Column Co. ..... *
Research-Cottrell, Inc. ..... *
Riley Stoker Corporation ..... *
Rockland Industries, Inc. ..... *
Roto Div. of Elliott Co. 78
Royal McBee Corp. ..... *

* Indicates firms advertising, but not in this issue

Sarco Company, Inc. 75
Seiscor Div. ..... *
Solar Aircraft Co. 34
Spence Engineering Co. ..... *
Sterling, Inc. ..... *
Stickle Steam Specialties Co. ..... *
Stone & Webster Engineering Co. ..... *
Superior Combustion Industries, Inc. .. 84

Taylor & Co., W. A. 100
The Terry Steam Turbine Co. 39

Union Iron Works ..... *
U.S. Electrical Motors, Inc. 89
Universal Atlas Cement Co. ..... *

Vogt Machine Co., Henry 7

Weinmann Pump Mfg. Co., The 101
Western Chemical Company ..... *
Western Precipitation Corp. ..... *
Wiedeke Co., The Gustav 96
Williams Gauge Co. 98
Wilson, Inc., Thomas C. ..... *
Worthington Corporation ..... Back Cover

Yarnall-Waring Company 12-13, 40
Yuba Consolidated Industries, Inc. .... *

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MANY FAST'S HAVE BEEN WORKING LONGER THAN YOU

It's a fact. There are plenty of cases where Fast's Couplings have been in service 20 to 40 years. And some of our more enthusiastic engineers say a Fast's should last forever if it's properly applied, installed and lubricated. Whatever opinion you accept, you can bet Fast's Couplings will give you the same smooth-running, low-maintenance, long-lived performance that makes them the choice of more equipment manufacturers than any other gear-type coupling.

For example, Fast's Coupling No. 1347, shipped in July, 1922, is still in service—and the customer is just ordering his first spare coupling 38 years later. KOPPERS COMPANY, INC., 1207 Scott Street, Baltimore 3, Md.

KOPPERS **FAST'S COUPLINGS**
Engineered Products Sold with Service

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We're on page 25

Single-Point pH Recorder (Strip Chart Assemblies also available)

CAMBRIDGE pH INDICATORS and RECORDERS

Labor saving — profit producing!

In addition to portable pH meters, Cambridge makes line-operated Direct Reading pH Indicators and Recorders for permanent installation. They are accurate, stable and assure continuous and trouble-free performance. Either the Recorder, Indicator or both, may be located at any reasonable distance from one or several sampling points. The Glass Electrodes are placed in vapor-tight housings of clog-free sampling chambers.

Send for Bulletin

CAMBRIDGE pH EQUIPMENT

CAMBRIDGE INSTRUMENT CO., INC.
1678 Graybar Bldg., 420 Lexington Ave., N. Y. 17, N. Y.

PIONEER MANUFACTURERS OF PRECISION INSTRUMENTS

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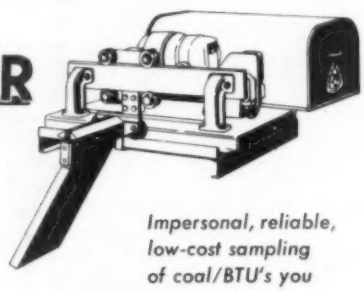
DENVER



AUTOMATIC SAMPLERS

Impersonal, reliable, low-cost sampling of coal/BTU's you buy or sell.

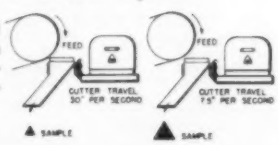
COMPLETE LINE OF SAMPLING AND SAMPLE PROCESSING EQUIPMENT

Wet, dry and dust-tight units. Simple, reliable, automatic. Units with cutter travel to 10' and longer. New bottom-dump dry cutters (patent pending) for use where headroom is 10."

Dimensioned layout drawings and specifications sent on request.

NEW...30"/sec. Cutter Speed

reduces bulk of material taken — often eliminates cost of secondary sampling—without affecting reliability of sample.



DENVER EQUIPMENT COMPANY
1400 17TH ST. • DENVER, COLORADO • CH 4-4466

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HAGAN NEWSLETTER—JULY

Behind the panel

HAGAN ALARM INDICATING MONITOR (AIM) GUARDS ATOMIC REACTOR

A Hagan AIM will monitor 75 temperatures on an atomic power reactor now under construction. Temperatures will range from 100F to 500F, and all are from condensers associated with the primary coolant loop. Combining all alarm functions in one instrument, the AIM will monitor any input which can be represented by DC voltages as low as 10 millivolts full scale, with an accuracy of plus or minus 0.1% full scale. The AIM provides maximum information on minimum panel space; the readout and alarm panel for 200 alarm points will fit into a 19" x 47½" panel area. (Details on request--ask for Item S-1)

ACCURATE POSITIONING--A MUST FOR DAMPERS ON TANGENTIALLY FIRED BOILERS

Several utilities have chosen the new Hagan 2½" x 5" Power Positioner to control secondary air dampers on new boilers now under construction. Reason--the superior accuracy and repeatability of the Hagan units. The electric operators previously used employ a braking device which is subject to variations in adjustment. Over a period of time, this variation could result in some dampers being wide open and others on the same unit almost closed. The Hagan Positioner avoids this possibility because no brake is needed for this pneumatic operator, and, in addition, each unit is individually controlled. All the control room operator has to do is turn the set point handle, and all the dampers move smoothly and accurately to the desired position. This exact position is held until the next signal is received. The Hagan 2½" x 5" Power Positioner is compact, simple and rugged. It is high speed--full 5" stroke in less than 2 seconds--and has a repeatability of plus or minus 0.3% of full scale. (Details on request--ask for Item S-2)

NET SOLIDS METERING SYSTEM SOLVES DREDGE PROBLEM

Here is a system that really paid for itself in the first month of operation. A dredging operation was to be paid in terms of the actual amount of solids removed. Before the Hagan system was installed, the dredges had been averaging only 40% of contract volume. Since the installation of the Hagan system, the dredges have been exceeding contract volume by 25 to 30%. The system measures fluid velocity and friction. By means of a series of automatic computations, actual net solids flow is derived. A recorder shows solids flow and corrected net solids density and integrates solids flow. Now operators can raise or lower the drag head to keep the net solids flow at maximum value at all times. Four such Hagan pneumatic systems have been installed on two barges. On order are four more systems that will operate in exactly the same manner as the pneumatic, but these will be Hagan PowrMag electronic controls. Actually, the electronic systems will be more accurate than the pneumatic, since the PowrMag system will be able to correct for dry solids. (Details on request--ask for Item S-3)

HAGAN CONTROL PACKAGE FOR BLAST FURNACE FUEL INJECTION

The steel industry, always on the lookout for better and more economical production methods, are pleased with the results obtained by the injection of hydrocarbon fuels into blast furnace tuyeres. Coke rates are reduced and iron production increased, and blast furnace operation is smoother. Hagan engineers have applied their wide experience in the steel industry to the development of a control system that makes the most of the advantages inherent in fuel injection. The system measures both blast air and fuel with a high degree of accuracy, since Hagan temperature and pressure compensated Ring Balance meters are used in this service, which overcomes the drastic metering errors of uncompensated devices. A simple ratioing loop, the Hagan system uses either electronic or pneumatic signals. Normal safety devices demanded by good practice are a part of the system. This control package can be made available on a schedule that meets most plant requirements. (Details on request--ask for Item S-4.)

HAGAN CHEMICALS & CONTROLS, INC., Hagan Center, Room 716, Pittsburgh 30, Pa.

HAGAN DIVISIONS: CALGON CO. — HALL LABORATORIES — BRUNER CORP.

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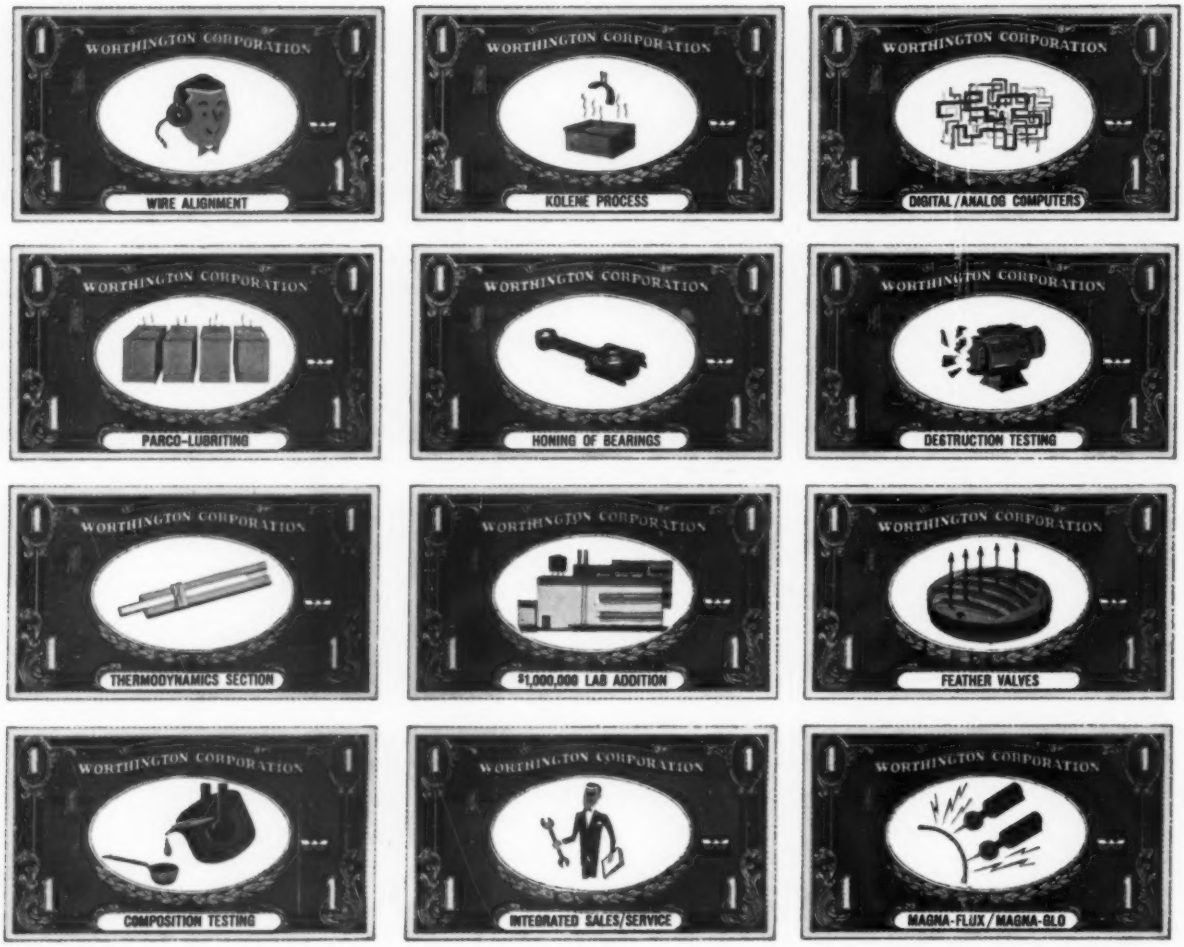
COMPRESSOR DOLLARS



WHAT'S IN THE PRICE?

These are dollars that are paid out every day for Worthington compressors. They reveal a few of the extra or "hidden values" that make the compressors worth most for the dollars invested. But even more important, they give a clue about real compressor values.

Today, rising costs and minimum profits compel every buyer to scrutinize compressor dollars more closely—to make sure they contain a full measure of value. In fact, your problem in determining the true value of a quotation is more difficult —but more important—than ever before.

What do we suggest? You must, of course, evaluate the price—dig for the "hidden values" buried in each manufacturer's offering with increased diligence. You can be sure that the values of prices will separate very quickly, because "hidden values" vary sharply in the compressor market today.

To help you isolate and evaluate competitive compressor offerings, we have prepared an objective "Compressor Evaluation Guide." This booklet points out the six key areas of judgment required for compressor evaluation and details them in full. Ask your Worthington Representative for this booklet or write Worthington Corporation, Dept. 36-18, Clinton Street and Roberts Avenue, Buffalo, N. Y. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

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